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OPEN-AIR STUDIES IN BOTANY

SKETCHES OF BRITISH WILD-FLOWERS IN THEIR HOMES

COMPANION VOLUME.

OPEN-AIR STUDIES IN GEOLOGY:
AN INTRODUCTION TO GEOLOGY OUT-OF-DOORS.

BY GRENVILLE A. J. COLE, M.R.I.A., F.G.S.,
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"WHEN DAISIES PIED."

PASTURE AT BALLYCASTLE, CO. ANTRIM, *April* 1896.

Frontispiece.]

OPEN-AIR STUDIES IN BOTANY:

SKETCHES OF BRITISH WILD-FLOWERS IN THEIR HOMES.

BY

R. LLOYD PRAEGER,
B.A., B.E., M.R.I.A.

Spiranthes Romanzoviana (Photo from Life.)

Illustrated by Drawings from
Nature by
S. ROSAMOND PRAEGER,

and Photographs from Nature
by R. WELCH.

"Come forth into the light of things,
Let Nature be your teacher."
WORDSWORTH.

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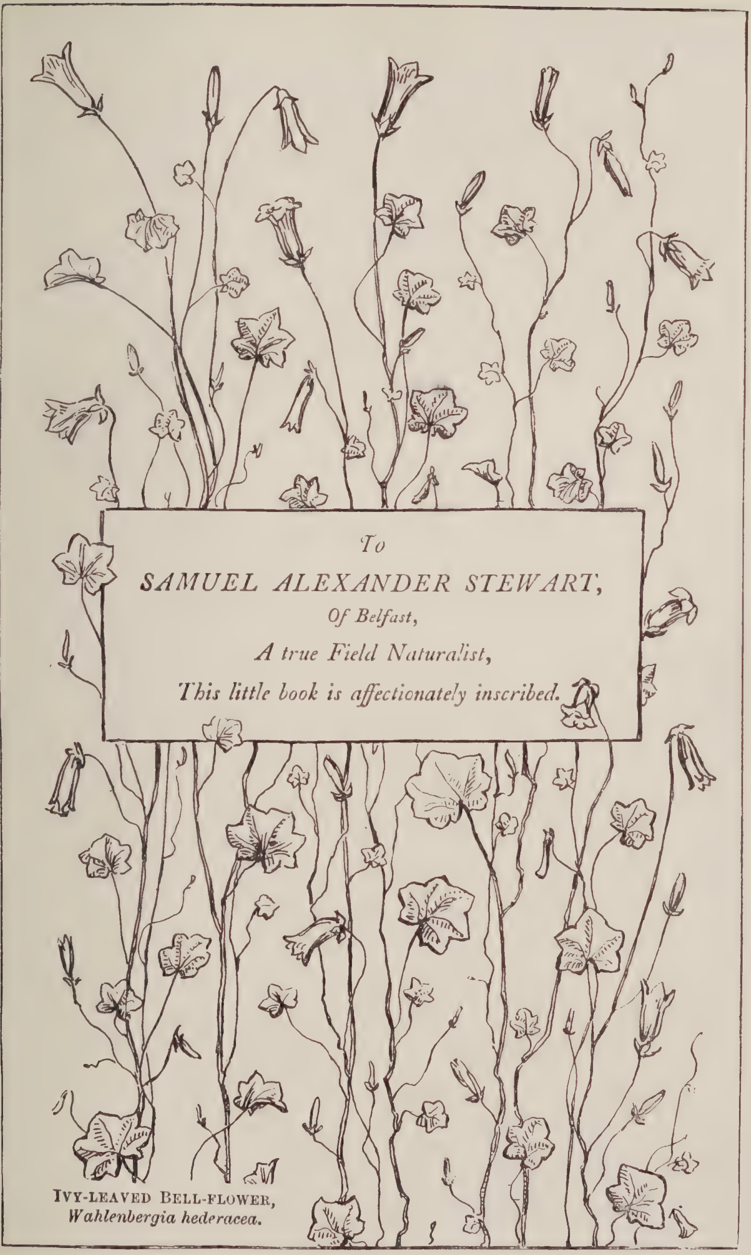

To
SAMUEL ALEXANDER STEWART,
Of Belfast,
A true Field Naturalist,
This little book is affectionately inscribed.

IVY-LEAVED BELL-FLOWER,
Wahlenbergia hederacea.

PREFACE

In the following chapters an attempt has been made to exhibit, by means of familiar scenes in our own Islands, glimpses of plant-life; interpreted not by the examining of microscopic slides in the laboratory, nor yet by the "conning of plant-mummies" in the herbarium, but by the study of actual scenes from nature. We stand, in fancy, out in the open country, with the wild-flowers at our feet, the hum of insects and the rustling of the wind in our ears, and the blue sky overhead, and we use those powers of observation that have been given to us. Thus only can we hope to comprehend the life of a plant or of a plant-community, and appreciate the conditions under which each species lives, and the adaptations by which each is able to maintain its position in the plant-world and fulfil its proper functions.

Being resident in Ireland, I have taken most of my scenes from the meadows or mountains, streams or sea-shores, of that fair land; but the majority of them will apply equally well to similar places in any part of the British Isles. Care has been exercised, indeed, to select spots not exceptional as regards their vegetation, and to choose as examples familiar wild-flowers, not rarities. Cheap and accessible English books have been quoted or referred to wherever possible, even though expensive works or treatises in other languages may be the recognised standards.

By reading the proof-sheets, Professor T. Johnson has rendered me valuable aid; and the descriptive portion of the work is much enhanced by my sister's drawings, and my friend Mr. Welch's photographs. It only remains to add that each scene is carefully described, plant by plant, from nature. The spot selected, and the date on which it was visited, are given at the head of each chapter.

R. Ll. P.

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OPEN-AIR STUDIES IN BOTANY

SCENE I

A DAISY-STARRED PASTURE

(Ballycastle, Co. Antrim, *April* 1896.)
[Frontispiece.]

> "When daisies pied and violets blue,
> And lady-smocks all silver-white,
> And cuckoo-buds of yellow hue,
> Do paint the meadows with delight."
> —*Love's Labour's Lost.*

The time is early morning, and the month is April. In front of us the Daisy-painted pasture stretches in undulating waves of vivid green all flecked with white: and where the screen of the young Sycamore leaves has intercepted the quickening sunbeams, the dew still glitters on the grass. The hedges have burst into leaf, and patches of brilliant verdure alternate with browner patches, where later shrubs grow among the Hawthorns. The Ash-trees that rise out of the hedge are yet bare of leaves, but are decked all over with short dark tufts of flowers, and the winged fruit of last year still clustering on the branches rustles in the breeze. A young Oak stands near by, robed in richest golden-brown, and close at hand, where the wind sings through the garden hedge, the early bees are humming round the sweet Sycamore flowers, and among the Brambles a Chiff-chaff is calling continually. Out of the sunlight the air is still keen, for—

> "'Tis a month before the month of May,
> And Spring comes slowly up this way."—Coleridge.

How the sense of **Spring-time** pervades everything!—all Nature is stirring; the trees, the grass, the birds and insects are all singing a spring-song, are crying out that it is Spring again. And we do not need to learn this lesson from the Primrose that is peeping from the hedgerow, the Chaffinch that hustles out of the thicket pursued by its mate, the western wind that shakes the Sweet Vernal Grass, or the bright sun flashing out from the changing fretwork of white and blue overhead; we feel in our veins the thrill of spring-time:—

"We feel right well,
How the sap creeps up and the blossoms swell;
We may shut our eyes, but we cannot help knowing
That skies are clear and the grass is growing."—LOWELL.

And what we feel, so indefinitely and yet so strongly, the greatest interpreters of human feelings, poets and musicians, have expressed with all the power and delicacy of their art. The joyous rippling melody of Gounod's "Au Printemps" and Mendelssohn's lovely "Spring Song," the triumphant chords of Henselt's "Frühlingslied," how they speak to us of singing birds and glancing streams, and flowers and blue sky; how they imitate the glad call of Nature, that—

"The Spring is here, the delicate-footed May,
With its slight fingers full of leaves and flowers!"—WILLIS.

And poets of all ages have loved to sing the same song. Every phase of this season has been lovingly described, whether it is the first stirring of the flowers, and birds and bees, when—

"Winter, slumbering in the open air,
Wears on his smiling face a dream of Spring."—COLERIDGE.

Or later—

"When proud-pied April, dressed in all his trim,
Hath put a spirit of youth in everything."—SHAKSPERE.

This is the month of which Tennyson writes—

"Now rings the woodland loud and long,
The distance takes a lovelier hue,
And drowned in yonder living blue
The lark becomes a sightless song."—*In Memoriam.*

Then comes the "Merrie Month of May," when—

> "There's crimson buds, and white, and blue;
> The very rainbow showers
> Have turned to blossoms where they fell,
> And sown the earth with flowers."—HOOD.

And the fullness of glory is reached in—

> ". . . Early June, when Earth laughs out
> When the fresh winds make love to flowers,
> And woodlands sing and waters shout;
> When in the grass sweet voices talk,
> And strains of tiny music swell
> From every moss-cup of the rock,
> From every nameless blossom's bell."—BRYANT.

To-day our task lies here, in this sunny meadow. We must examine some of the wild-flowers that fill the pasture and deck the neighbouring banks, and try to know them, to learn their mode of life, their habits and customs, their likes and dislikes, their names, their relationships. The Daisies stretch right up to the shadow of the Sycamores which fringe the garden, but under the trees they are much fewer, and in their place we get tall plants of Wild Chervil and the nodding blue flowers and shining leaves of the Wild Hyacinth; clearly some plants prefer the open sunlight, others love the shade. The Daisies were all closed when we crossed the meadow last night, now they are wide open; the leaflets of the Clover were drooping and folded, now they are fully expanded; it is evident that plants are affected by heat and cold, by light and darkness. In the breezy pasture the plants are all low-growing and compact; under the trees they are mostly taller, and often slender; in the hedgerow there are many too slender to stand alone, which scramble up through the interlacing branches to some height, or deliberately twine round their taller neighbours, and thus raise themselves to the light and air. Manifestly in each place the plants are adapted to their surroundings. And then look at the abundance and variety of them. There are tall trees, succulent herbs, and tiny creeping plants, some like each other, some very unlike. We must endeavour to group them, and to know them by name. To do this, it is necessary that we should carefully compare them. And to compare them, we must learn to recognise the different parts of which each is made up, and to notice the modifications which these parts undergo in different kinds of plants; thus we shall obtain definite ideas of their similarity or dissimilarity, and be able to classify them. It is, indeed, with this portion of plant-lore that we will be chiefly concerned in our open-air studies—the outward appearances of plants, by which they may be recognised and referred to their proper place in the plant world; but we must inquire at the same time how these parts are constructed, what is their use, and why they assume the varied forms which we shall notice.

Let us, then, select a few spring flowers at random, and compare them one with another; we shall easily acquire a smattering sufficient to allow us to proceed to the more detailed examination of the flora of our pasture and of other places. Out of the shelter of the hedgerow we gather specimens of the **Wild Hyacinth** (*Scilla festalis*) and the **Lesser Celandine** (*Ranunculus Ficaria*)—not by rudely grasping their delicate herbage and tearing it from the roots, but by carefully removing the fine soil, so as to obtain the whole plant, root and all. They grow under a **Hazel** (*Corylus Avellana*), a month ago gay with pretty yellow tassels, which are now rapidly fading as the young leaves peep forth; a sprig of this will be useful to us also. Scrambling up the hedge is the **Bush Vetch** (*Vicia sepium*)—let us gather this as well. How different our four plants are in size and shape and colour. All, however, are composed of essentially the same parts—of *roots, stem, leaves,* and *flowers.*

The **roots** are easily recognisable in all. In the Hazel they are long, strong, and woody, much branched, and well capable of securely anchoring the tree in the exposed positions which it frequents. In the Bush Vetch we find an underground creeping *root-stock,* a perennial stem which gives out annual leafy shoots above and delicate roots below; this subterranean colourless root-stock is apt to be confounded with the roots proper. In the Hyacinth numerous soft, white roots spring from the base of the round bulb. In the Lesser Celandine the roots are white and fibrous; among them, and not to be confounded with them, are numerous elongated *tubers;* these belong to the stem rather than to the root, and are useful to the plant as storehouses of food-material.

The **stems** of our plants offer much variety. In the Hazel they are tall, much branched, woody, and lengthen year by year; they form a *tree-trunk*, and on them are borne leaves and flowers. The Bush Vetch possesses the creeping underground stems we have already mentioned, and also annual leafy stems, which are very weak and can scarce hold themselves upright. In the Hyacinth a different and curious arrangement is found. Here also there is a perennial root-stock, in the shape of a flattened disk, from the under side of which roots are given off. On the upper side it is enlarged by a number of peculiar fleshy scale-like leaves, which wrap round the growing-point and assist to protect and nourish it. These and the flattened root-stock form the familiar *bulb*. Each season this root-stock sends up a number of narrow, smooth leaves and a tall leafless flower-stem, which fade and disappear when the function of flowering and fruiting has been duly performed. In the Lesser Celandine we find a leafy stem and numerous leaves, springing from a very short root-stock, which gives out below the tubers already mentioned. The stem lengthens and flowers, produces seed and fades, but the root-stock remains, ready to produce stems the next year.

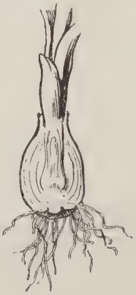


FIG. 1.—SECTION OF BULB OF WILD HYACINTH (*Scilla festalis*). Half natural size.

We examine next the **leaves** of our four plants. Note the difference of shape and texture. In the Hazel they are oval, with a tapering point, hairy, and the half of the leaf on the left side of the central vein or *midrib* is of different shape from that on the right. There is a straight central vein, on each side of which a set of parallel secondary veins are given off, which give off smaller veins. The edge of the leaf is cut into large teeth, and the edge of each of these teeth is cut into smaller teeth. The leaf of the Bush Vetch is different; it is *compound*, not *simple*, as in the Hazel. On each side of a central stalk roundish hairy *leaflets* are borne in opposite pairs; such a compound leaf is styled *pinnate*. The central stalk terminates not in a similar leaflet, as is usually the case in leaves of this shape, but in a delicate tendril, which coils round the stems and twigs of neighbouring plants. At the base of the leaf, where it joins the stem, there is a pair of small leafy structures; these are the *stipules;* we shall return to them immediately. The leaves of the Wild Hyacinth are strap-shaped and narrow, smooth and succulent; the arrangement of the veins is different from that of any of the leaves we have examined. There is no central vein from which others are given off, but a number of parallel veins of equal size run the whole length of the leaf —an arrangement, as we shall afterwards see, characteristic of a very large group of plants, of which the Wild Hyacinth is one. In the Lesser Celandine the leaves are roughly heart-shaped, smooth and shining, traversed by spreading branching veins, and have a smooth or slightly-lobed margin.

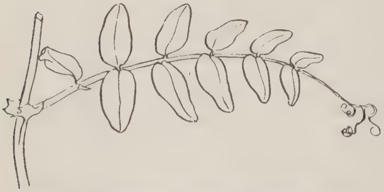


FIG. 2.—LEAF OF BUSH VETCH (*Vicia sepium*). Half natural size.

When we come to examine the **flowers** of our plants, we find the comparison much more complicated and puzzling. Let us first take a flower of the Lesser Celandine, and note its different parts; with this type before us we shall more easily understand the arrangement of the others. In the Celandine, then, the flower is solitary, on the end of a slender stalk. It consists of several rings of leaves, of different shape and colour, clustered so close together as to appear to spring simultaneously from the summit of the flower-stem. The rings nearer the centre are less leaf-like than the outer ones. The outermost ring, and the lowest, consists of three green oblong leaves. They wrap the inner portion of the flower while it is young, and drop off as the seed ripens. This outer green ring is the *calyx*, and the leaves of which it is composed are called *sepals*. Next comes a ring of eight to twelve glistening, bright yellow leaves, oblong, and longer than the sepals, opening wide in sunlight, closing over the inner portions of the flower in rain or darkness. This ring is the *corolla*, and each leaf of which it is made up is a *petal*. Inside the corolla is a ring of numerous small narrow club-shaped leaves, also bright yellow in colour, arranged, like the other rings, not all at exactly the same level. These are the *stamens*. Examine one of them carefully. It consists of a short stalk, the *filament*, and a club-shaped head, the *anther*. The anther is divided into two lobes by a groove running lengthwise along the back and the front. When the anther is fully developed, each of these lobes splits open, and allows a fine yellow dust to escape. This dust is *pollen*, the male element of the flower, and it is of the greatest importance in the continued life of the species. Inside the ring of stamens is yet another set of floral leaves—a crowded group of somewhat bottle-shaped bodies, forming the centre of the flower, at the summit of the stem. Each consists essentially of a lower hollow portion, the *ovary*, which contains a small white body the size of a pin's head, the *ovule*, and a cellular tip, the *stigma*. Taken collectively, these form the *pistil*, and each of them is called a *carpel*.

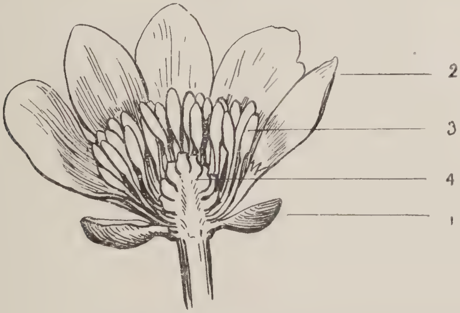


FIG. 3.—SECTION OF FLOWER OF LESSER CELANDINE, *Ranunculus Ficaria*.

1, Sepals, forming the calyx ; 2, Petals, forming the corolla ; 3, Stamens, or male organs ; 4, Carpels, or female organs.

Let us now examine the flowers of our other three plants. The Bush Vetch has dull purple blossoms in little clusters which spring from the *axils* of the leaves—that is, from the angle formed by their junction with the stem. The flowers do not stand vertically, but assume a horizontal or declining position—a feature characteristic of the Order to which this plant belongs. The sepals are "fused" together into a somewhat bell-shaped calyx, their only separate portion being the tips, which project as five teeth of *unequal* size; in other words, the calyx is *irregular*. The petals are still more unequal. A large, broad, curved one, called the *standard*, occupies all the upper portion of the flower, forming a kind of roof. Two other petals of equal size, the *wings*, each having a backward-pointing lobe, stand one on each side below this; and the bottom portion of the corolla is made up of a curious folded or boat-shaped petal, the *keel*, which is in reality two petals attached along one edge. The corolla, we see, is extremely *irregular*. The stamens likewise exhibit a peculiar arrangement. They are ten in number. Nine of them have their stalks (filaments) united into a long tube which surrounds the ovary; the tenth one is separate. The pistil also is very different from that of the Celandine. Instead of a number of separate carpels, each consisting of a one-seeded ovary surmounted by a stigma, we find here only one carpel with an elongated many-seeded ovary, at the extremity of which, on a short stalk (*style*), which bends upwards, is placed the stigma.

On looking next at the blue flower of the Wild Hyacinth, we perceive another arrangement. Instead of two outer rings of flower-leaves, differing in number and shape and colour, in this plant each ring consists of three segments, and all are similar; in such a case the calyx and corolla are together styled a *perianth*. The six segments of which it is composed do not expand widely, but spread only near their extremities into a graceful bell-shape. There are six stamens; three of them are attached for about half their length to three of the perianth-segments. The pistil consists of a short roundish many-seeded ovary, formed of three carpels fused together, surmounted by one slender style bearing the small stigma. Finally, we take one of the drooping yellow catkins of the Hazel. This is very different from any floral structure we have hitherto examined. A large number of yellowish downy scale-leaves are closely disposed all round a lax drooping stem. To one side of each scale two smaller scales adhere, and on each pair of these, attached to their junction, are eight stamens. There is no calyx, no corolla. Neither can we discover on the catkin any trace of ovary, or style, or stigma. The catkin is, in fact, a collection of male flowers. To find the female flowers we search other parts of the twigs, and soon find them nestling in little scaly buds, which contain no stamens—only one or two pairs of crimson stigmas, each pair placed on a two-celled ovary, the whole surmounted by a bell-shaped leafy sheath at the summit of the scaly buds.

To make our examination of the four plants which we collected complete, we should see them when the **fruit** is mature; and as we cannot sit down and wait for such a development, we must anticipate a little. In the case of the Lesser Celandine, the sepals, petals, and stamens soon wither away; the ovaries grow a little as the fruit ripens, but not much change occurs in their shape and size. In the Bush Vetch rapid growth succeeds the period of flowering, and the ovary develops into a long narrow pod, like that of a Pea, which finally splits open lengthwise. In the Wild Hyacinth, when the flower fades, the nodding stem and drooping ovaries become erect; the ovaries increase in size, develop into three-sided capsules, and at length open at the top, showing the black shining *seeds* within. In the Hazel, the male catkins wither and drop off when they have shed their pollen. The ovaries in the female flowers, on the other hand, grow during the summer, and produce the familiar hazel-nuts, each of which contains a single large seed, the kernel.

We have next to consider briefly the **functions** of the several portions of the plants we have been examining—the part which each takes in the complicated processes by which the plant grows and produces seed. To begin with the commencement of growth. When a seed germinates, as it does in the presence of a suitable amount of heat and moisture, a small root grows out and pushes its way down into the earth. This little root, the *radicle*, soon begins to absorb water from the soil. Meanwhile a little shoot, the *plumule* or incipient stem, has likewise appeared, and, turning upwards, seeks the light and air, sends out leaves, the first generally of very simple shape, and the seedling is fairly embarked on life's journey. The plant, therefore, consists essentially of two portions—a downward-growing portion or root, destitute of leaves and flowers, and an upward-growing portion or shoot, on which leaves and flowers are borne. The **root** anchors the plant securely in the ground, and its grand function is to absorb from the soil for the use of the plant raw food-matters, such as saltpetre, dissolved in water. The numerous substances which the plant obtains in this way are of vital importance to it. The **stem** or **axis** is the central framework upon which the leaves and flowers are borne. It supports them, conveys to them, by means of the veins which run continuously from root through stem to leaves, the water absorbed by the roots, and grows in such a manner as to place them in the most favourable position for fulfilling their several functions. The **leaves** are, like the roots, organs of absorption, and they also are the chief outlet for the waste water of the plant. In the *epidermis* or skin of the leaf, and usually on the under side, there are numerous very small openings called *stomata*. Through the stomata the water, which served to convey from the roots the various salts derived from the soil, passes out to the atmosphere. But they have another important function. We know that most leaves are *green* in colour. This greenness is caused by the presence of a substance called *chlorophyll*, which is distributed in minute particles throughout the cells of which the leaf is built up. Chlorophyll, in the presence of sunlight and water, possesses the peculiar power of decomposing carbonic acid. Carbonic acid is a compound of carbon and oxygen. Through the stomata, carbonic acid is absorbed from the atmosphere, where this gas is always present in small quantity. The carbon thus procured is taken by the plant and converted, along with the hydrogen and oxygen of which water is composed, and the other substances which are held in solution by the water absorbed by the roots, into the complicated compounds of which the tissues of the plant are built up. The oxygen set free by the decomposition of the carbonic acid is returned to the atmosphere. Thus we see that roots and leaves act together, and between them mainly supply the food required by the plant for its continued health and growth. The decomposition of carbonic acid and water, and formation of starch and other food-materials, is termed **assimilation.** As the leaf consists mainly of living cells, the process termed **respiration** is continually going on, not only in the green parts of plants, but in every portion, and equally in plants which contain no chlorophyll. By this process carbonic acid is exhaled and oxygen absorbed, the carbon thus liberated being due to the waste of the living substance contained in the plant-cells—the **protoplasm,** the source of the plant's vital energy.

Besides the regular foliage-leaves, most plants have other smaller leafy structures on certain portions of the stem. Two small leaf-like outgrowths frequently adorn the leaf-stalk near its junction with the axis; these are called *stipules.* We may easily find them in the Bush Vetch (Fig. 2). Small leaves are frequently developed a short distance below the flowers; these are termed *bracts;* they may be seen on the Wild Hyacinth, one placed at each point where a flower-stem or *pedicel* leaves the main stem; in this plant we note that they are coloured blue, like the blossoms.

The **flowers** are that portion of the plant in which the all-important function of reproduction is carried on. The supreme aim of all plant-life is to secure the successful and perfect reproduction of its species, and thus we find that roots, stem, and leaves, by maintaining the life of the individual plant, subordinate themselves to this great end; the flower is the culmination of the growth of the plant. The functions of the curiously-modified flower-leaves which have been already described, must be briefly indicated. The sepals and petals, as we have seen, enclose the inner portions of the flower while it is young, and thus protect them till they are mature. We often find the sepals composed of tough material, and covered with hairs or spines, suitable for repelling the attacks of insects. The corolla frequently closes over the stamens and pistil at night or during rain, and preserves them from cold and damp. The petals of the Lesser Celandine, for instance, open only in warm or bright weather. Another important function of the corolla is to attract insects to the flower, by means of its brilliant colour. The powerful perfume of many flowers has the same purpose, and a similar function is performed by the honey which is secreted by so many species. But neither sepals nor petals are *necessary* portions of the flower; in some plants one or other is absent, and in others again they cannot be distinguished one from the other; in some species both are wanting. They are adjuncts of the essential and all-important organs, the stamens and pistil. In order that perfect seed may be produced, it is necessary that mature pollen should reach the pistil; and, furthermore, it is usually essential for the well-being of the future race that the pollen should be not that of the same flower, but of a different flower, or of a different plant, of the same species. The various arrangements by which the distribution of the pollen is ensured and regulated are among the most marvellous and intricate of all the varied features of plant-life. A few cases we shall meet with in our future studies; for the present it is enough to say that much pollen is wind-borne, and also that insects visiting the flowers in search of honey play an all-important part in the fertilisation of a large number of species. Once the act of fertilisation has taken place, the corolla and stamens usually fade; the calyx in some cases remains and again exercises a protecting influence, closing over the fruit during the period of ripening, and opening when it has reached maturity. Meanwhile in the pistil minute changes of great importance are going on. Each pollen-grain, nourished by the stigma which it has reached, sends out a very delicate thread, the *pollen-tube.* This pushes its way through the substance of the stigma, and passing down the interior of the style, where it receives nourishment as it goes, enters the ovary and reaches the *embryo-sac* (an enlarged cell in the ovule) through a minute opening in the coat of the ovule. In this embryo-sac there is an extremely small body called the *egg-cell.* From the tip of the pollen-tube a little body, the *male cell,* passes into the embryo-sac and fuses with the egg-cell. This is the act essential for the production of fertile seed. The fertilised egg-cell becomes the seedling plant. In the embryo-sac the embryo and its food-supply now develop, and the ovule becomes a young seed.

The first leaves of the plant, a single one or an opposite pair, usually develop in the seed and form lobes, which often occupy a large portion of the space inside the seed-coat or testa; these are the *cotyledons.* The food-supply is sometimes stored up in the young plant (as in the Vetch) while it is still in the seed; sometimes the food-matter is stored up apart from the seedling, and is not absorbed till after the seed commences to germinate. The embryo when fully developed consists of a little bud, the incipient stem or *plumule*, and an incipient root or *radicle*, and bears one or more seed-leaves or cotyledons. While these changes are taking place in the seed, the ovary grows and matures, expanding into a *fruit*, which varies much in shape and size in different kinds of plants. When the seed is quite ripe the fruit becomes detached from the plant, or opens and allows the seed to escape. The seed being scattered on the ground—and in this connection again we meet with an amazing variety of ingenious devices to assist dispersal—it will, under suitable circumstances, commence to grow, and thus the cycle is complete.

The above sketch of the different parts of a flowering plant and their functions, supplies but the merest outline of the elements of this subject, and, indeed, a host of important facts are altogether omitted. But into a work like the present, in which the utmost aim of the writer is to draw light sketches of wild-flowers in their homes, and to indicate characters by which the rambler may know and name them, physiological and structural botany may enter only to a limited extent, however fascinating these branches may be. Ours is a holiday task; our schoolroom is not the laboratory, but the open air, among the bees and birds, with the clear sky above us and the open country on every hand; and we see not with the microscope, but with the naked eye. When we have had our holiday we may return, glowing with health and rich in field-lore, to probe with microscope and dissecting-knife into the inner secrets of plant-life, and gain by degrees some conception of the marvellous beauty and intricacy of the structure of even the humblest plant.

All this time the **Daisies** have been spread before us, and yet we have not examined one of them. This we will now do. In the roots and leaves we find no essential difference compared with those of some of the plants we have already scrutinised. But the flower at once strikes us as being something altogether novel. We look into it carefully, and soon perceive that it is in reality a large number of small flowers crowded together. The summit of the stem is expanded into a broad surface like a conical pin-cushion, and on these the tiny flowers are closely packed, as will be clearly seen if with a penknife we cut down vertically till we reach the stalk. The flowers of the edge are strikingly different from those of the centre. Let us look at one of the central flowers first. We remove it carefully from its place on the expanded top of the stem, or *receptacle*, and examine it with the aid of a magnifying-glass. The calyx is quite absent; the yellow corolla is tubular and regular, split at the top into five short acute spreading segments. The arrangement of the five stamens is peculiar. They spring from the corolla-tube, and, though their filaments are separate, their anthers are united, forming a little tube round the style, which is long and straight, and terminates in a two-lobed stigma. One important point must be noted. In the Lesser Celandine, and Bush Vetch, and Wild Hyacinth, the calyx, corolla, and stamens all joined the stem *below* the ovary; in botanical phrase, they were *inferior;* in the Daisy, however, the ovary is below, and the petals and their adherent stamens spring from its top—in other words, they are *superior*, the ovary is *inferior*. The white outer flowers differ greatly in shape from the inner ones. No calyx is to be seen; the corolla is very irregular, consisting of a long narrow flat *limb* extending outwards, in shape like a single petal of the Lesser Celandine; at the base it is tubular and surrounds the style, which terminates in a forked stigma. There are no stamens; the flowers are therefore *imperfect*, and, having pistils only, they are *female*. The whole head of flowers is closely surrounded by a double row of bracts; when bracts thus surround the base of a group of flowers, they are termed an *involucre;* an involucre must not be confounded with a calyx, which is the outer ring of leaves of a *single* flower. To summarise, then, the Daisy bears heads of flowers which are surrounded by an involucre. The flowers are sessile on a conical receptacle. They are of two kinds; the flowers of the *disk* are yellow, regular, tubular, and perfect; those of the *ray* are white, irregular, ligulate, and female.

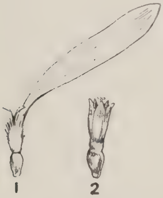


Fig. 4.—Florets of the Daisy (*Bellis perennis*). Enlarged.

1, Ray-floret;
2, Disk-floret.

Before we go further, a word must be said as to the **classification** of the great host of flowering plants. We have already noticed that the embryo of the Lesser Celandine, Bush Vetch, and Hazel has *two* cotyledons, while that of the Wild Hyacinth has only *one;* the difference is one of much importance, and on it is founded the division of flowering plants into two great *Classes,* **Dicotyledons** and **Monocotyledons.** Other important differences usually accompany this one. In dicotyledonous plants the parts of the flower are usually in *fives* or *fours,* or multiples of five or four; the veins of the leaves are arranged in a *network;* the stem increases in thickness by the addition of new layers on the *outside,* between the outer skin or bark and the woody tissue. In monocotyledonous plants the parts of the flower are usually in *threes,* or some multiple of three; the veins of the leaf are *parallel,* and do not form a network. The further subdivision of these Classes depends on the arrangement of the parts of the flower, and under the **Sub-Classes** thus formed the plants are grouped in **Natural Orders.** The Natural Orders are not defined by any one or two structural differences, but rest on the broader basis of a general similarity of characters in the plants which are placed together under them. A further subdivision is made into **genera**, and further into **species.** As a matter of fact, no classification of plants which splits them all into definite groups can be altogether satisfactory or accurate, for Nature is not shackled by hard and fast rules or boundaries, and certain Orders, genera, and species of plants shade into each other by imperceptible gradations. Nevertheless, the *convenience* of such a grouping is so manifest, that, while botanists may differ as to what Order or genus some intermediate form of plant should be referred, or the precise amount of distinctness that should constitute a species, all agree as to the desirability of such a scheme of classification.

A very few words is all that need be said here on the subject of **nomenclature**—the naming of plants. The Classes and Sub-Classes derive their names from some leading character; for instance, *Dicotyledons* for the plants possessing an opposite pair of seed-leaves, *Polypetalæ* (many-petalled) for that division of them in which the petals are free from one another, as in the Buttercup, Wall-flower, or Stitchwort. The Natural Orders are named either from some leading character of the group, such as *Umbelliferæ* (umbel-bearing plants) or *Labiatæ* (lipped flowers); or else from some typical genus of the group, such as *Ranunculaceæ* (from *Ranunculus*, the Buttercup), or *Urticaceæ* (from *Urtica*, the Nettle). The genera and species derive their names from various sources. Often they are descriptive of some character or property of the group or individual, often called after some place or person. When we wish to specify any particular plant, we mention first its generic and then its specific name, thus: *Ranunculus repens* (Creeping Buttercup); *Polygala vulgaris* (Common Milkwort); *Cochlearia anglica* (English Scurvy-Grass). This method of naming plants was devised by the great Swedish botanist, Linnæus. If we wish to be quite explicit, we will add to these names that of the botanist who first bestowed them on the plant, thus: *Ranunculus repens*, Linnæus (often contracted into "Linn." or "L."), since in some cases the same name has been used by different botanists for different plants.

Now let us come back to our meadow. Growing among the Daisies are scores of the black heads of the plant we know so well as Cocks-and-Hens. This is the **Ribwort** or Ribwort Plantain, **Plantago lanceolata**. Note the numerous long, narrow, pointed leaves, with prominent ribs; as in the Daisy and Wild Hyacinth, they all spring from the root-stock—they are all *radical*. The flower-stems are tall, slender, and furrowed; they are unbranched, and the flowers, which are not stalked (*sessile*), are crowded together at the top of them; in other words, the flowers are borne in a *dense spike*. The most prominent part of the flowers is the four long yellow stamens which each of them bears. The lowest flowers of the spike open first, and thus we get a ring of bright stamens, the position of which ascends as successive flowers bloom and fade. These stamens have a long, slender filament, to which the anther is lightly attached, so that it dangles freely, like those of many Lilies. The corolla is inconspicuous, because it is dark brown in colour, and its four pointed lobes lie flat against the surface of the spike. The lower part of the corolla is tubular, surrounding the long, slender style, which emerges from the corolla before the stamens. If we break the head across, we find that each flower has a calyx of four small green sepals, below which is a little bract of about the same size. Several other kinds of Plantain are common also. **P. major, Greater Plantain,** frequents roadsides and waste ground. It is easily known by its very broad, egg-shaped, stalked leaves and long spikes of green flowers. Birds are very fond of the seed. **P. media, Hoary Plantain** or Lamb's Tongue, is a less abundant plant. It has broad, almost sessile, downy leaves. The spikes are intermediate in length between those of *P. lanceolata* and *P. major*, and they look pink in colour, owing to the conspicuous purple filaments and yellow anthers. **P. maritima, Sea Plantain,** is, as its name implies, a plant of the sea-coast, though, like many other maritime plants, also found on high mountains. It is a less attractive plant than the others; its long, very narrow, fleshy leaves are alone enough to distinguish it. **P. Coronopus, Buck's-horn Plantain,** is a pretty little species, with a basal rosette of narrow leaves; unlike any of the other British species, the leaves are *pinnatifid*, or cut into lobes almost to the midrib; the lobes are long, narrow, and pointed. This plant is common, particularly on light ground near the sea. The only other British member of the Order is a little lake plant, *Littorella*, which we shall meet with in a future ramble (p. 124).

We stoop to pick up a small object that the wind has just thrown at our feet. It is one of the winged fruits of the **Ash.** The flat, oblong seed is enclosed in a tough dry coat, which broadens out into a membranous wing. Here we see one of the numberless contrivances devoted to the dispersal of seeds. To-day there is but a gentle breeze, yet this fruit has flown at least fifty yards from the swaying tree-top where it has spent the winter. In a strong gale—when, be it noted, a greater number of fruits are sure to be torn off—it would have been carried much farther. And what, it may be asked, does the plant gain by having its seeds thus thrown far from the parent-plant? We have all noticed that farmers do not sow the same crop in a field year after year. They have learned by experience that the crop deteriorates if they do. The reason of this is that the plant exhausts certain properties in the soil—uses up in the building of leaves and branches and fruit the available supply of certain materials—and, if re-sown too often, it suffers for want of this necessary food. In the same way wild plants would suffer if they could not reach new soil from which to draw fresh food-supplies. And thus we find in nature a large variety of beautiful devices for the **dispersal of seeds**. There are seeds that fly and seeds that crawl, seeds that are shot out by the parent-plant like little cannon-balls, seeds that lie in wait for animal passers-by, and are by them carried far away; there are seeds which wriggle into the ground and grow forthwith, and there are seeds which will quietly wait for years till the peculiar conditions necessary for their development arrive. We shall have opportunities of viewing more closely some of these interesting dispersal-contrivances in our future rambles.

But let us examine the Ash-tree from which the fruit has just fallen. First note that, like the Hazel, it is a **tree**—that is, the upright stem lengthens year by year by the growth of the terminal bud, and branches arise from buds in the axils of the leaves, which in their turn grow and give off branches. If the stem did not increase in strength in the same proportion, it would soon be not strong enough to support the weight and strain of the branches. We know that it does increase regularly by means of an annual deposit of fresh woody material immediately beneath the bark. The inner layers, meanwhile, undergo a gradual change. The walls of the cells of which they are composed get very thick and strong and dry, and at length form tough *heart-wood*. On account of this intermittent deposit of fresh layers the wood is not of exactly the same character all through, and we can easily trace the annual additions in the stem of a tree that has been cut across; these are the well-known rings of growth, by counting which we may tell with accuracy the age of the tree. The bark cannot in most cases stretch indefinitely to fit the constantly-increasing girth, and hence the surface of our Ash-tree is all rough with vertical slits where it has ruptured; but fresh layers of bark form at once underneath to protect the all-important zone of active growth that lies within. It is interesting to note in passing that the stems of climbing trees, which rely on their neighbours to support their weight and protect them from storm, do not thicken to any great extent. Thus the Ivy, which grows in a dense branched mass to the very top of the tall Scotch Fir beyond the garden there, has a stem no thicker than one's arm; and the Woodbine may be often seen trailing up to a height of twenty or thirty feet with a stem as slender as one's finger. The ends of the drooping Ash branches are grey, and knotted with swellings at the opposite pairs of scars left by last year's leaves. From the upper scars grow the many-flowered clusters of brown blossom, and last year's clusters of fruit still cling to the branches. Examine the flowers; they are entirely destitute of both calyx and corolla. Each flower is reduced to its essential organs—a short pistil, which tapers from a thick base, and a pair of stamens, one on each side of it. A few of the flowers, we may notice, are destitute of stamens, and a few others have no pistil. At the apex of the stem, and just above the scars which last year's leaves have left, are the leaf-buds of the coming summer, safely wrapped in tough blackish scale-leaves. When the young leaves expand these will fall off, their work being accomplished. The Ash is one of the two British species which represent the Order **Oleaceæ,** of which that important and well-known tree, the Olive, is the type. The other British representative of the group is the Privet, *Ligustrum vulgare,* so much used in hedges on account of its compact and rapid growth.

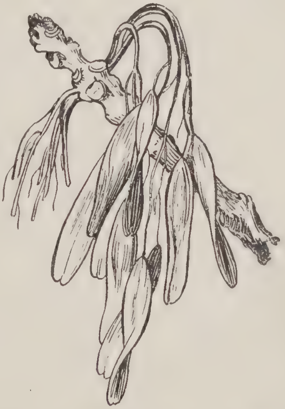


FIG. 5.—WINGED FRUIT OF ASH (*Fraxinus excelsior*), with stem showing leaf-scars and buds. Half natural size.

One other plant, of a widely different type, we will examine before concluding our first ramble. This is the **Sweet Vernal Grass, Anthoxanthum odoratum.** The generic name refers to its conspicuous anthers, which are yellow or purple; the specific name, to its fragrance when dried. This plant we may use as a type of that large and universally-distributed Order, the **Grasses,** or **Gramineæ.**

No race of native plants is more graceful or ornamental than this, the—

> "Flowering grasses, green and golden,
> On their slender stems upholden,
> In the breezes waving, bending,
> Beauty to the field-paths lending."

So accustomed are we to see Grasses everywhere, that we are inclined to fail to realise how remarkable is their abundance, and how much this means in our agricultural and domestic economy. Though in Britain there are not more than between thirty and forty species which are really *common*, yet in actual number of individuals the Grasses overtop all other flowering plants put together. The value of Grasses as a food-supply for the animal kingdom is immense. The seeds of certain kinds have furnished from remotest antiquity staple articles of food for mankind—wheat, rice, barley, rye, oats, maize; and the foliage of many others is of no less importance to hundreds of herbivorous animals. In the British Isles the tallest Grass does not exceed a few yards in height, but in the Tropics magnificent species of Bamboo rise almost to the stature of forest-trees. But from these we must return to our little *Anthoxanthum.* Note the narrow pointed parallel-veined leaves so characteristic of Grasses and the allied group of Sedges. Some spring from the base of the slender unbranched flower-stems; others are borne upon the stems, and have a long lower part, which closely clasps round the stem, and a flat free upper portion. Note the curious little leaf-like process (the *ligule*) where the *lamina* or blade of the leaf joins the sheathing portion—a feature characteristic of Grasses. The stem is slender and wiry, as in most of our British Grasses. It is hollow, except at the well-marked *nodes*, where the leaves are given off; at these points it is swollen and solid. At the summit of the stem, arranged in a series of close short branches, or *spikelets*, are the flowers. These are quite different from any of the flowers we have examined hitherto. In place of a calyx and corolla, or herbaceous perianth, the flowers are enclosed in chaffy boat-shaped scales, the *glumes.* Each flower has two conspicuous stamens, with large anthers on long slender filaments, and a pistil with two long feathery stigmas and a short ovary. The perianth is in some cases represented by two very small scales; in other cases it is quite absent. The scales which enclose the flower are of unequal size; the outermost is much smaller than the second, which is the largest of all; the next two are small and hairy, and possess *awns* —that is, their midribs are prolonged into delicate spines, such as we see very conspicuously in the Barley and Rye; the innermost two are very small. The number, size, and arrangement of these scales varies much in different species. The Grasses are a difficult group, and we may well set them aside for the present, to be taken up again when our eyes have become trained and our perceptions quickened by the examination and comparison of many different plants, whose larger flowers with more differentiated parts will prove less puzzling. But our Vernal Grass is an example of a large and important group of plants, and of a type of flower that we may instructively compare with the various other flowers we have found in our meadow.

But we have learned enough for one day—

> "To-morrow to fresh fields and pastures new."

SCENE II

UNDER THE HAWTHORNS

(DUNDONALD GLEN, CO. DOWN, *May* 1896.)

"Now the woods are starred with eyes ;
Now their weeds and mosses through
Peep the white anemones,
Daisies pink and violets blue ;
Flowers they spring ;—
Birds they sing ;—
All to swell the pomp of spring."
—WILLIAM COX BENNETT.

HERE, below the Hawthorn-trees, the wild-flowers spread in an unbroken carpet as far as the eye can penetrate the interlacing stems. From this verdant floor rise the brown rough trunks of the Hawthorns, and the tall white poles of young Ash-trees, and the grey-mottled stems of the branching Hazels; and all are woven together overhead into a low netted roof, which here and there allows the sunlight to creep through and dapple the verdant ground. Close behind us a steep bank rises, thick with Hazel-bushes. In front, a singing brook swings round in a semicircle; it is full of brilliant moss-grown boulders, and where a stray sunbeam lights up the brown water, we can see the caddis-worms moving on the gravelly bottom and the flies dancing overhead. Beyond, a high wall of boulder clay rises almost vertically from the stream, crowned with a tangle of Blackthorn and Ivy, which effectually bounds our view. From the mossy stump on which we sit the level flowery floor stretches to the stream, a dozen paces in front and to right and left, and this little patch of natural garden will furnish us with abundant material for our second study. For here are congregated many spring wild-flowers that love the shade. The Wood-Anemones occupy dense patches, with widely-opened blossoms rising above the dark foliage; Wild Hyacinths are everywhere, and it is their glossy leaves that chiefly form the unbroken green carpet; Primroses are clustered here and there, and Lesser Celandines; and the beautiful purple flowers of the Early Purple Orchis add a fresh touch of colour. The most striking foliage is that of the Cuckoo-pint, and among its arrow-shaped leaves rise the pale green spathes. That patch of brilliant green is the fresh young leaves of the Wood-Sorrel, and around the rotting log close by Dog-Violets are peeping out. Farther away, on the right, is a little depression filled with the leaves and white starry blossoms of the Broad-leaved Garlic, more pleasant to see than to smell; and on the left a young bush of Blackthorn is almost smothered by the profusion of Greater Stitchwort that has overrun it. This spot a Hedge-Sparrow has chosen for her nest, and artfully concealed it in the thick tangle; so much so that we can hardly get a glimpse of the five sky-blue eggs that it contains.

Let us now look more closely into some of these wild-flowers. A few of them we have already examined—the Lesser Celandine and Wild Hyacinth are old friends. Taking a flower of the **Wood-Anemone, Anemone nemorosa,** we are at once struck by the similarity of its structure with that of the Celandine; we find a number of carpels set on a receptacle just as in the other plant, and the carpels are similar in shape and in their arrangement. In point of fact, these two plants are closely allied, and both belong to the Order **Ranunculaceæ,** of which the Buttercups are typical representatives. But some striking points of difference between this plant and the Celandine we notice at once. There is an underground creeping root-stock; each flower has a setting of three leaves of the same shape and size, which spring from near the top of an otherwise leafless stem; and we cannot distinguish any green calyx such as the Celandine possesses. This involucre of leaves surrounding the flower is characteristic of the Anemones. As regards the perianth, it is the petals that are absent in reality, and the sepals are coloured and in every respect resemble petals. The Anemones are not the only genus of *Ranunculaceæ* in which the petals are suppressed. In the Meadow-Rue, *Thalictrum*, the small sepals take the place of petals; and in the well-known Marsh-Marigold, *Caltha palustris*, the five bright yellow "petals" are in reality sepals, which have assumed all the appearance of the yellow petals of its cousins the Buttercups. In the Globe-flower, *Trollius europæus*, the large yellow petaloid sepals curve inwards, closing the flower and hiding the small narrow petals inside. The Winter-Aconite, *Eranthis hyemalis*, has a similar conspicuous calyx and inconspicuous corolla, and the same disparity of size is found in the large green flowers of the Hellebore, where a ring of small petals lies inside the five large broad sepals. In the Columbine, *Aquilegia*, the calyx and corolla have the same bright colour, and are similar in texture, but normally the five sepals are flat, ovate, and pointed, while the five petals possess a curious funnel-shaped spur, which extends backwards and ends in a hook. In the Larkspur, *Delphinium*, we get a still more abnormal arrangement. The five sepals are large and of a glorious blue. The upper one is prolonged backwards into a slender tube. The paler corolla consists of one rather hood-shaped petal, which has likewise a long tube or spur, which is enclosed in the spur of the upper sepal. The Larkspur, it will be noted, is the first member of the *Ranunculaceæ* we have seen which has irregular flowers, and in this respect it acts as a connecting link by which we reach the Monk's-hood, *Aconitum*, the well-known flowers of which are exceedingly irregular. In this plant we find five large deep blue sepals, of which the upper one is very large and helmet-shaped. The petals are much smaller. The two largest lie inside the helmet-shaped sepal. They are long and narrow, with a curious club-shaped and spurred head. The other three are very small, and often altogether absent.

Thus it will be seen that in the *Ranunculaceæ* we find many examples of the enlargement and coloration of the calyx at the expense of the corolla; and from the series of plants we have just examined we may gather several hints. We must not assume that a certain floral whorl is a *corolla* because it is conspicuous and brightly coloured. It is necessary to examine the near relations of the plant which bear it, and there seek for hints as to its real affinity. Nor must we jump to the conclusion that certain plants must belong to different Orders because they differ widely in external appearance. The hooded flowers of the Monk's-hood, the green bells of the Hellebore, the yellow Buttercups, and minute flowers of the Meadow-Rue, appear as unlike each other as they could well be, yet in all we find the superior ovary, numerous free stamens, and separate carpels which help to distinguish the Order *Ranunculaceæ*. *How* these differences of shape have arisen, and *why* they exist, are questions that it is difficult or impossible to answer. To attempt to answer them, we would need to study the whole Order, not only the few British examples; to inquire into their development, their environment, and the hundred circumstances that affect their well-being. Then, perhaps, we might begin to understand the reason of these things, and find that each form of structure possesses a definite advantage to the plant which possesses it, and has a direct bearing on its life-history.

The Anemones grow in definite patches. This is accounted for by their creeping stems, which do not spread far, but slowly grow and branch, so as to form a network. Two other species of Anemone which are occasionally met with in Britain, though not true natives, grow in a similar way; these are **A. apennina,** which has pretty blue flowers, and **A. ranunculoides,** in which the blossoms are yellow and Buttercup-like. One other species inhabits our islands, and is a genuine native; this is **A. Pulsatilla,** the beautiful **Pasque-flower,** a rare plant, found on chalky downs in England only. This plant differs in appearance from the Anemones just mentioned in that it does not creep, but has a short, erect, perennial root-stock, which produces a flower-stem, on which are borne an involucre of three sessile leaves and a very large purple flower, and also a tuft of finely-cut root-leaves. It is interesting to note that, while the creeping species have small roundish seeds, the Pasque-flower, which has not this means of spreading, has seeds with a long feathery tail, suitable for dispersal by the wind on the open downs which it frequents; such seeds would be of little service to the creeping species, all of which haunt sheltered thickets and woods.

The moss-grown, rotting log in front of us is quite a little garden of wild-flowers. Along its top the **Wood-Sorrel, Oxalis Acetosella**, has established itself—an advantageous position, where it gets abundance of light and air, and draws rich food from the crumbling, soaking timber. A delicate and graceful plant this. Its creeping stems are bright pink, and knotted with the bases of former leaves. The pretty flowers rise on slender stalks, which bear a pair of small bracts and a single blossom. The petals are very delicate and beautiful, white in colour and veined with purple, with a yellow spot near the base of each. The Wood-Sorrel is exceedingly sensitive to changes of temperature. At sunset the delicate petals close over the stamens, and the three leaflets fold together by bending downwards till they meet. Many plants exhibit similar movements. The flower-heads of two common plants belonging to the Order *Umbelliferæ*, the Wild Carrot, *Daucus Carota*, and the Burnet-Saxifrage, *Pimpinella Saxifraga*, may be observed to droop in the evening till the flowers point downwards instead of upwards. The trifoliate leaves of many Clovers, Melilots, and Medicks close at night like those of the Wood-Sorrel, but by rising up till they meet, instead of by drooping. The closing of the petals of flowers at night, or even during the day, is familiar to every one. Many seedlings spread their cotyledons wide to the rays of the sun, and in the evening raise them close over the delicate growing-point of the young plant. The object of all these movements is the same—to keep the plant, or portions of it, warm. Heat is just as necessary to plants as it is to animals. During the day plants eagerly drink in the heat-rays of the sun, and at night they take great care that the heat so acquired is not lost by excessive radiation. We have all noticed that water which is freely open to the sky freezes sooner than water which is overshadowed by trees. This is because the covering of boughs prevents the rapid radiation or giving out of the heat which the water holds. Similarly the drooping umbel of the Wild Carrot, with the leafy involucre spreading over it like an umbrella, is protected from excessive radiation by assuming this position; still better are flowers protected whose petals at night fold closely over the delicate and vital parts. Many plants there are, of course, which do not require such protection, and stare boldly all night long at the chill starry sky; and others appear to even shun the heat and glare of day, and open only after the sun has set. Well do I remember the first time I gathered the **Night-flowering Catchfly, Silene noctiflora.** The plant grew in a dry sandy field, its flowers all tightly rolled up. They were brought home, placed in water, and visited at midnight; and, behold! the delicate pale-pink blossoms were fully expanded, and emitted a delicious fragrance. Next morning they were closed as tightly as ever. The question may naturally be asked, is not this nocturnal blossoming prejudicial to the welfare of the plant? The evidence on this point is remarkably interesting. We find that the night-flowering species of *Caryophyllaceæ*, to which Order the Catchfly belongs, are frequented by certain nocturnal moths, which not only sip honey from the flowers, but also lay their eggs in the ovaries. These insects carry pollen from one flower to another, and the all-important function of fertilisation is thus duly accomplished. By day the flowers, not requiring the offices of bees or butterflies, quietly rest. By night they open, and by their pale colour and fragrance attract the insects whose assistance is needed to ensure the fertility of the plant.

The reasons for the closing of certain flowers during a portion of the day are not so apparent. The cause, in some instances, may be to prevent the approach of insects that would be of no use in fertilising the flower, while by being open very early they secure the visits of useful species which are early risers. In other cases, the flower appears to close at the time when the visits of certain useful insects cease—just as a tradesman will put up his shutters when there is no prospect of further customers.

But we have rambled far from our mossy stump. Two slender plants straggle across its farther end—plants with trailing shoots bearing opposite pairs of broadly egg-shaped serrate leaves and axillary *racemes* of slightly irregular flowers. The one we recognise at once by its familiar bright blue blossoms; it is the **Germander Speedwell, Veronica Chamædrys**; the other is a plant of less wide distribution, the **Mountain Speedwell, V. montana**. Here are two plants very similar in general appearance, and apt to be confounded by the beginner; but we have only to compare them to detect many points of difference. It is not often, however, that one has so favourable an opportunity of contrasting them as we have in the present instance, for *V. Chamædrys* usually favours dry sunny banks, while *V. montana* loves the deep shade of woods. Hence the great assistance that we gain by making a collection of dried plants—which can never, it is true, take the place of living plants for purposes of study, but nevertheless are invaluable for reference. Comparing our two Speedwells as they intertwine, we readily find means of distinguishing them, and we may emphasise the more striking differences and impress them on our memories by tabulating them as follows:—

	V. Chamædrys.	*V. montana.*
Stem . .	With two opposite hairy lines.	Hairy all round.
Leaves .	Sessile ; dark green.	Stalked ; light green.
Flowers .	$\frac{1}{2}$ inch across ; bright blue.	$\frac{1}{4}$ inch across ; pale lilac.
Fruit . .	Shorter than the calyx.	Longer than the calyx.

Short notes like these of the points of difference between species which resemble each other, and which prove troublesome to the student, made at home from whatever text-book he uses, and referred to in the field, will often be found very useful. This method possesses one distinct advantage over the alternative of bringing a specimen home for determination—that it accustoms the student to recognise his plants *in the field.* After a couple of closely-allied species have been distinguished once or twice he comes to know the general appearance of each plant, the indescribable differences of growth and habit and colour, the individuality, in fact, that marks each plant however nearly related, and which the trained eye alone recognises and appreciates. Failing some method such as this, it will often be only at home, in the evening or on the next day, that the young botanist will discover that he has found some interesting or rare plant, and the opportunity of studying it in the field—where alone it can be studied with full advantage—may be gone for ever.

Examine the flowers of our two Speedwells. The calyx consists of four green sepals, which persist in fruit. The corolla is four-lobed. The uppermost lobe is considerably larger, and the lowest considerably smaller, than the other two. From the tube of the corolla *two* stamens project, a feature which distinguishes *Veronica* from all other British genera belonging to the Order *Scrophularineæ.* The stamens spread horizontally, and the one slender style stands out between them. The fruit is a flattened, two-lobed, somewhat heart-shaped capsule; the capsule varies in shape in different species, and furnishes an important means of recognising them. **Veronica** is a large genus; about a hundred and sixty species have been described: they grow chiefly in temperate regions, where many of them form shrubs, and almost all are pretty and graceful plants. In some foreign species the foliage is reduced to short wiry or scaly leaves, which closely resemble those of certain Cypresses and Club-Mosses. The dozen and a half species that are found in our islands are all herbaceous, and most of them are small plants. The inflorescence is racemose; in other words, the flowers are usually borne in *racemes*—that is, on a long common stem which bears numerous stalked flowers; if the flowers had no stalks, the inflorescence would be called a *spike.* The British Speedwells can be

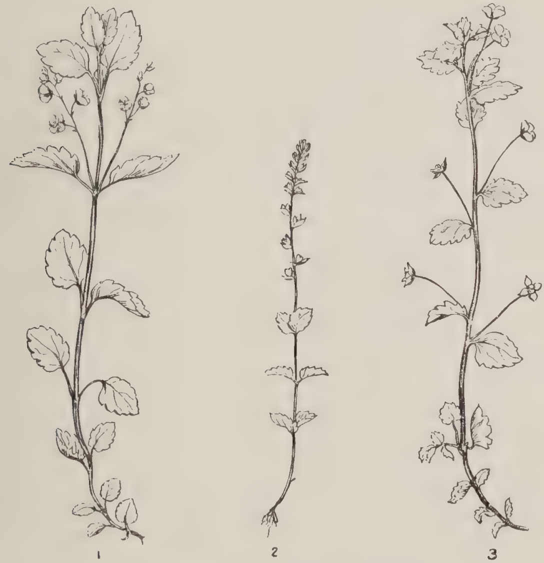


Fig. 6.—Types of British Speedwells.

1, *Veronica montana ;* 2, *V. arvensis ;* 3, *V. Tournefortii.*
Half natural size.

conveniently divided into groups, according as the racemes spring from the axils of the leaves or form the termination of the stem—according as they are *axillary* or *terminal;* while a third group includes species in which the flowers are scattered along the stem instead of being borne near its summit, and appear singly in the axils of the leaves. A sketch of a representative of each group is given (Fig. 6), which may be useful as illustrating these characters, and also three common types of inflorescence.

V. Chamædrys and *V. montana* (Fig. 6), as we have seen, both belong to the group with axillary racemes. The other British representatives of this group are as follows: **V. officinalis**, the **Common Speedwell**, a creeping plant of heaths and dry banks, with hairy egg-shaped leaves and rather long racemes of small pale lilac flowers, which have very short stalks. **V. Beccabunga**, the well-known **Brook-lime**, a smooth and shining plant with succulent procumbent stems, oval glossy leaves, racemes in opposite pairs, and bright blue flowers; it lives in ditches and streams. **V. Anagallis-aquatica**, the **Water Speedwell**, the largest British *Veronica*, is an erect, often bushy plant, with a tall (1 to 4 feet) succulent stem, long tapering smooth leaves, and numerous opposite pairs of many-flowered racemes. The stalk of each flower, or *pedicel*, is short, and the flowers are small and pale blue. Lastly we have **V. scutellata**, the **Marsh Speedwell**, easily known by its weak stem, narrow, almost grass-like leaves, and lax alternate racemes of pink flowers, borne on long spreading pedicels.

Of the second group, those with terminal racemes, two, **V. fruticans** and **V. alpina**, are found only on the summits of Highland mountains, and are not likely to trouble the beginner. Two others, **V. verna** and **V. triphyllos**, are very rare English plants; they may be known from other British species by their *pinnatifid* leaves—leaves, that is, which are cut into segments nearly to the midrib. *V. verna* is a very small plant with almost sessile flowers; *V. triphyllos* is larger, and the flowers are stalked and the stem spreading. Two others are common plants; **V. serpyllifolia**, the **Thyme-leaved Speedwell**, a little perennial with smooth shining roundish leaves, and long upright spike-like racemes of very small pale blue flowers; and **V.**

arvensis, Field Speedwell (Fig. 6), a small annual with broad serrate leaves, which get narrower as they ascend, till near the top of the stem they are finger-shaped and very small; the flowers are minute and blue in colour. Lastly, there is **V. spicata**, the handsomest British Speedwell, a rare plant, with comparatively tall leafy stems terminated by long spike-like racemes of bright blue flowers, and lanceolate leaves. **V. hybrida**, which is generally looked on as a robust variety of this, has broader leaves, taller stems, and denser racemes. Both have the tube of the corolla longer than broad, by which character they are distinguished from any other member of the section.

There is left that section in which the flowers are borne on simple axillary stems or *peduncles*, as the stem of a solitary flower, or of a group of flowers, is technically called; it comprises—**V. agrestis, V. polita, V. Tournefortii** (=*Buxbaumii*), and **V. hederæfolia**. The last of these is easily known by its leaves divided into five lobes by two deep incisions on each side, so as to recall the leaves of the Ivy, *Hedera*, from which it derives its name. The other three bear a considerable resemblance to each other. All have ovate (egg-shaped), cordate (heart-shaped) leaves with serrate margins, trailing stems, bluish flowers, and capsules which are *obcordate*—that is, heart-shaped with the broad end upwards. *V. Tournefortii* (Fig. 6), is much the largest of the three, having stems one to two feet long, and conspicuous blue flowers; the peduncles are much longer than the leaves; the capsule is large and flat, with a keel or thin edge running round its margin. It is not a native of Britain, but having been introduced, it has spread rapidly, and is now a common weed everywhere. Its original home is in Asia and Eastern Europe. *V. polita* has sharply-toothed leaves, shorter than the peduncles, broad pointed sepals, and small wholly blue flowers. In *V. agrestis* the leaves are less toothed and generally longer than the peduncles, the sepals narrower and blunter, and the smaller flowers have the lowest corolla-lobe white. These last two are somewhat difficult to distinguish.

Here on the bank, among the dense shining coat of Wild Hyacinth leaves, we make a discovery—a strange, pale, fleshy plant, very different from anything that we have found before. It possesses nothing that resembles leaves, and the thick succulent flower-stems are pinkish in colour and three to six inches in height. They bear numerous pinkish short-stalked drooping flowers, which are all turned one way; each flower is sheathed by a rather large pink bract. If we carefully dig, we find that the flower-stem springs from long branching underground stems which are white and fleshy, and densely clothed with succulent white or greyish tooth-like scales. The whole plant has something uncanny about it, the effect partly of its strange scaly stem and partly of its pallid colour. This is the **Toothwort, Lathræa Squamaria**, one of the most curious and interesting of British plants. We have seen that most plants have green leaves or stems, and that the greenness is due to the presence of chlorophyll, which

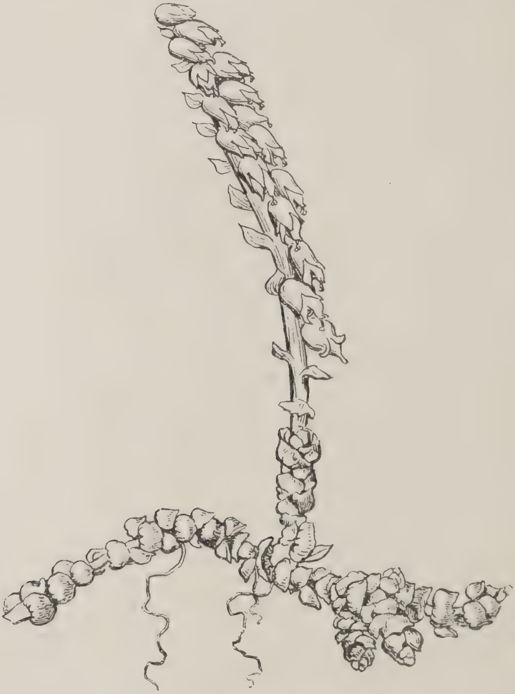


FIG. 7.—TOOTHWORT, *Lathræa Squamaria.* Half natural size.

is of vital importance to the plant in enabling it to obtain carbon by decomposing carbonic acid, and to manufacture food-material. Yet here is a plant from which chlorophyll is altogether absent. How does it procure its food? We shall reach the solution of the mystery if we carefully follow the course of the thin white roots which the Toothwort sends out from its scaly stem. They spread to the roots of the Hazel beneath which the plant is growing, and are firmly attached to these roots by little disks. A microscopic section shows that the cells of the Toothwort root have forced themselves into the growing roots of the Hazel. By this means the Toothwort draws nourishment from the plant to which it has fixed itself. We now see why it has no need of chlorophyll; it does not manufacture its own food-materials, but steals them ready-made from other plants. The Hazel appears to be its favourite host, but it victimises also several other trees and shrubs, such as Oak, Beech, Ash, Elm, and Ivy. The seeds of the Toothwort are small and numerous, and are in consequence easily dispersed. Each contains a well-developed radicle, plumule, and cotyledons. The seeds germinate in damp earth. The delicate radicle penetrates the soil and sends out lateral roots. These wind about as if seeking for a host-plant, and if they find a root of one of the species which the Toothwort affects, they at once develop suckers and draw nourishment from the host. The primary bud in the seed then grows rapidly, and elongates into the scaly subterranean stem we have just examined. If the roots fail to find a suitable host-plant, the young plant by degrees withers away, for the roots are incapable of drawing nourishment from the soil in the ordinary way.

We must now consider the whitish fleshy scales with which the subterranean stem is covered. These are without doubt the modified leaves of the plant. The investigations of botanists have shown that they are of peculiar structure and have a special function. Each leaf is bent backwards on itself, so that the apparent back and front of the leaf are really both part of the front surface, and the true back surface is inside. In the thickened leaf thus formed a number of chambers are excavated, which open by tiny holes into the little recess formed by the recurved tip of the leaf, below the point where it joins the stem. These chambers act as veritable death-traps for minute animals, such as Infusoria and Rotifers. When they enter the chambers, by chance or in search of food, they get entangled by minute threads proceeding from stalked cells with which the inner surface is studded, and perish, and their juices are absorbed by the plant. In this remarkable way the Toothwort supplements the food-supply which it draws from the roots of its host, and, though the amount of food thus absorbed by any one leaf must be very small, it is to be remembered that every one of the numerous leaves is continually doing its share of this work, and, moreover, can work all the year round, while the root-fibres work only portion of the year, as they decay in autumn, and do not again develop till the following spring.

The Toothwort is a member of the same Natural Order as the Speedwells, which we have recently examined—the large and important Order **Scrophularineæ,** of which the Foxglove, Snapdragon, Mulleins, and Figworts are familiar examples; and though it stands alone among British members of the Order in living underground and being destitute of chlorophyll, it is by no means the only one that has developed a **parasitic habit.** Several genera that are common in meadows, pastures, and heaths, the *Euphrasia* or Eyebright, *Rhinanthus* or Yellow Rattle, *Melampyrum* or Cow-wheat, *Pedicularis* or Lousewort, and *Bartsia*, have green leaves which absorb food from the atmosphere, and also suckers by which they feed on the juices of neighbouring plants. But none of these species are so dependent on the host-plant as is the Toothwort. When their seed germinates, the young plant grows freely for some time on the products of its own absorptive exertions, before attaching itself to the roots of other plants, and experiments have shown that some of this group can grow and flower in the absence of any host-plant. One very remarkable instance must be mentioned, that of *Bartsia alpina*, which in the British Isles is found only in a few mountainous districts in Scotland and the North of England. This plant has *four* means of obtaining food. By means of its green leaves it carries on the process of assimilation; by disks on its roots it sucks the juices of other plants; and by root-hairs, similar to those of ordinary plants, draws nourishment from vegetable soil. Lastly, by means of scale-leaves, modified in a manner somewhat similar to that of the Toothwort, borne on subterranean buds which are formed in the autumn, it obtains a supply of organic food by the destruction of small animals.

Thus it is seen that in the *Scrophularineæ* there are many plants which live the ordinary independent life of self-supporting members of the plant world. Others have acquired a parasitic habit, with more or less loss of the power of root-absorption direct from the soil. Others again have developed carnivorous habits, and we have two extreme cases in *Bartsia alpina* and *Lathræa Squamaria*, the former of which is both parasitic and carnivorous, without having lost the power of absorbing by either its leaves or its roots, the latter of which is dependent on its parasitic and carnivorous habits for its very existence.

Still more completely parasitic than the Toothwort are the **Broom-rapes, Orobanche,** along with which the former was until lately usually placed, as a member of the Order **Orobanchaceæ.** All of these are leafless root-parasites. The Broom-rapes have not got a creeping root-stock like the Toothwort, but attach themselves to one point of a root, where they form a swollen scaly bud, which sends up stout leafless scaly brownish stems, bearing numerous two-lipped flowers. The most important particular in which they differ from the parasites which we have been considering is in the structure of the seed and the development of the young plant. The seed does not contain a definite bud, root, and cotyledons, but consists of a group of quite undifferentiated cells, surrounded by others containing a small store of reserve food. When growth commences, a delicate spiral filament grows from the seed downwards into the ground. If it fails to find the root of a suitable host, it withers away without any further vegetative effort, being quite unable to absorb food from the soil. If, however, it meets with a root of its host-plant, it adheres to it closely, and begins to swell immediately above the point of attachment. As the lower end increases in size the upper shrivels and at length disappears, and a knobby bud is left seated on the root of the host, and this bud in course of time sends up into the light and air one or more annual flower-stems.

A number of species of Broom-rape grow in our islands, but most of them are not of common occurrence. The one figured is **O. Hederæ,** which lives on the roots of the Ivy. The stem is brownish in colour, the flowers yellowish. **O. major** is the largest British species, having a very stout stem, often two feet in height, and flowers of a brownish colour; it is parasitic on Leguminous shrubs, such as Furze and Broom. **O. rubra** grows on the roots of Wild Thyme, in basaltic districts chiefly; the whole plant is dark red. **O. elatior** is a handsome species, with pale yellow flowers, growing on *Centaurea Scabiosa.* **O. minor** is commoner, infesting Clover and other plants; the whole plant is brownish-yellow with purplish streaks. Several other species have been found in Britain, including **O. ramosa,** which has a branched stem; **O. purpurea,** with bluish-purple flowers; **O. caryophyllacea,** with large yellowish flowers, striped with brown or purple; **O. Picridis,** a yellowish species, with smaller flowers, growing on *Picris hieracioides;* and **O. amethystea,** which is purplish, and is parasitic on *Daucus* and *Eryngium.* Altogether about a hundred species of this Order have been described; all are leafless root-parasites, with a strong family likeness, and as the individual species vary a good deal, there is some doubt as to the distinctness of many forms. The variety of food and surroundings caused by the various species growing on plants of very different kinds appears to produce considerable variation in the parasite, as indeed might be expected.

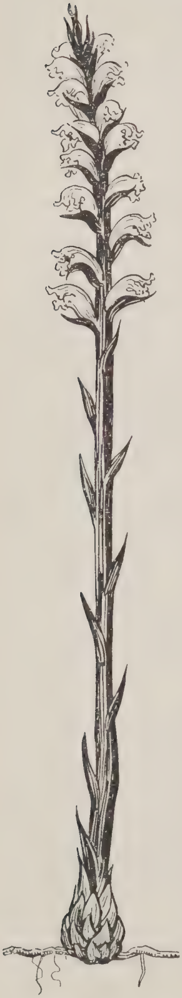


FIG. 8.
IVY BROOM-RAPE
(*Orobanche Hederæ*).
Half natural size.

But from these dingy uncanny parasites let us return to honest self-supporting plants. The squat colourless Toothwort is indeed a misshapen dwarf compared with this tall and graceful herb that grows on the bank beside it. By its flat circular clusters of small flowers, borne on numerous short stems that radiate from one point of the main stem, and by its much-divided leaves, we at once recognise a member of that large and important Order, the **Umbelliferæ**. It is the **Wild Chervil, Anthriscus sylvestris.** Let us examine it, for it will serve as an illustration of the Order to which it belongs. The root is thick and spindle-shaped. The stem hollow, furrowed, much branched, and a yard in height. The leaves are beautiful and delicate. We have already seen *pinnatifid* leaves, which are cut into lobes nearly to the midrib, and *pinnate* leaves, which are divided into two rows of separate leaflets. In the Chervil we find leaves which are *tripinnate;* that is, the pinnæ are themselves divided into secondary pinnæ or *pinnules,* and these again similarly divided. The effect is very feathery and graceful, and much-divided leaves like these are characteristic of the *Umbelliferæ.* Some of the leaves are radical; others spring from the stem, and in these the petiole or leaf-stalk widens out as it nears the axis till it assumes the form of a semicircular channel, and clasps the stem half-way round. In some species, such as the common Wild Angelica and Cow-Parsnep, the petioles are much more widened still, and develop into great egg-shaped membranous sheaths. These broadened petioles are found in many Umbelliferous plants. But it is the inflorescence that is so peculiar and well marked that it enables us generally to tell at a glance any member of the Order. Every branch of the stem, close to its extremity, splits into a dozen or more radiating branchlets or *rays,* forming an *umbel;* and each of these again, close to its extremity, divides into a dozen or so of similar but much smaller branchlets, each of which bears a little white flower. Both the general umbel and the secondary umbels (or *umbellules*) have the outer rays longer than the inner ones; the effect of this is that all the flowers lie in nearly the same horizontal plane, and a continuous flattish surface of small flowers is the result. Each umbellule has a ring of lanceolate bracts at its base, forming an involucre, called a *partial* involucre to distinguish it from the *general* involucre, which in many *Umbelliferæ* surrounds the base of the whole umbel, but which is absent in this species. Each of the small flowers has a long inferior ovary, with a flat top, round the margin of which are set five little white petals, and alternating with them five stamens. No calyx is to be seen; the two styles are short, seated on the broad top of the ovary. Our plant does not yet display any seed, but it will be well to premise and describe the fruit of the *Umbelliferæ*, as it is of peculiar structure, and as the tribes and genera into which the Order is divided are based chiefly on variations in its structure. The fruit consists of two carpels, which adhere by one of their faces to a central axis, from which they finally separate from below, remaining attached at their upper extremity. Each carpel contains a single seed, attached to its upper extremity. The free outer faces of the carpels are marked by five vertical ridges, between which are often four intermediate ones; and in the wall of the carpel, under each ridge, or under the furrows which lie between them, there are generally long narrow cavities filled with oil. It is chiefly by the shape of the carpels, and the distribution of the ridges and oil-cavities, that the many genera of *Umbelliferæ* are distinguished—differences which the beginner will find it hard at first to grasp. But here again out-of-door eye-practice will do much, and though most species of the Order have a strong family resemblance, well-marked differences of root and stem and leaf and flower will be detected one after another, and each species identified and recognised leaves one less to puzzle and confuse. It may be added that the sense of smell will be found a useful ally in learning the *Umbelliferæ*. They are a highly-scented race of plants. We all know the characteristic odour of Celery and Parsley, the strong aromatic smell of Fennel and Samphire and Sweet Cicely, the stench of Hemlock and Water-Dropwort. The British *Umbelliferæ* are all herbaceous plants. Some live in pools and streams; most on dry land. They have generally branched hollow stems, finely-cut leaves with clasping petioles, and umbels of small whitish flowers. Many of them are highly poisonous; some yield valuable drugs; the roots of Parsnep and Carrot are familiar vegetables; the leaves or stems of others, such as Celery and Parsley, are eaten; and the fruit of Caraway, Anise, &c., yields aromatic oils. Several characteristic members of the Order we shall come across in our future rambles, and a small group of rather abnormal forms, with simple leaves, and heads rather than umbels of flower, will be treated of when we come to speak of the Sea-Holly (p. 71).

Let us next examine the **Cuckoo-pint, Arum maculatum**, which has been already noted as one of the most striking wild-flowers in our little glade. In this plant we see one of the three British representatives of the large Order **Aroideæ**, a curious race of plants, numbering about a thousand species, and widely distributed over the world. The other British species are **Arum italicum,** a rare South of England plant resembling *A. maculatum*, and **Acorus Calamus,** the **Sweet Flag**, which will have a place in our

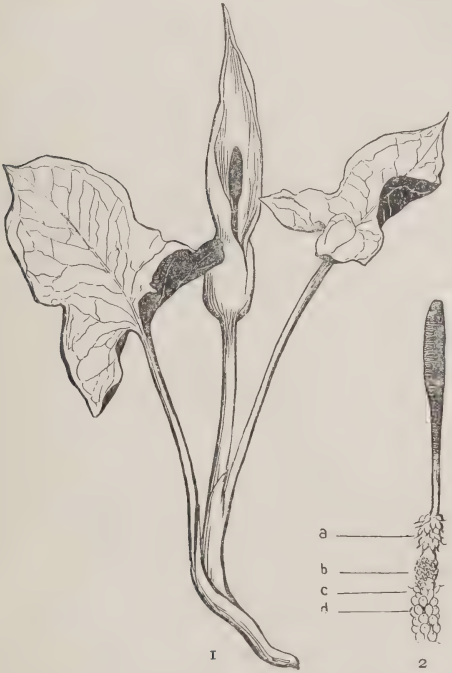


FIG. 9.—CUCKOO-PINT, *Arum maculatum*.

1, Inflorescence and leaves (quarter natural size); 2, Spadix, showing the groups of flowers, the spathe being cut away (half natural size).

a, abortive ovaries; *b*, anthers; *c*, abortive ovaries; *d*, fertile ovaries.

"riverside" scene (pp. 54, 55). Observe the thickened tuberous root-stock of the Cuckoo-pint. Like every other part of the plant, it is highly acrid and poisonous, but baking transforms it into a wholesome food. The leaves are large, glossy, and arrow-head shaped, the basal lobes being long and pointed; they are borne on petioles which have sheathing bases, and they are sometimes spotted with dull purple. The inflorescence is very peculiar. The flowers are minute, and are borne in rings on a stout column or *spadix*, which is continued upwards into a long blunt-topped purple club-like head. Below the rings of flowers a large greenish sheath or *spathe* springs from the stem, and far overtops the spadix. At its base it is closely sheathed, and hides the flower-rings, but opens above and displays the club-shaped head within, and terminates in a long pointed hood. Strip away the leafy spathe and examine the inflorescence which it so safely encloses. This is one of the most peculiar-looking floral structures to be found among British plants. It consists of rings of flowers of the simplest possible structure. Lowest of all are a number of sessile ovaries, small yellowish globular bodies, with a minute stigma and style. The uppermost ones taper into thread-like extremities and are barren. Above these is a well-defined ring of purple nearly sessile anthers, each two-celled, and connected, usually in pairs, by very short broad filaments with the central column. Above the anthers is a ring of yellow flask-shaped bodies with thread-like terminations, which are usually considered to be abortive ovaries. A few days after this complicated inflorescence arrives at maturity, the spathe droops and withers, the upper portion of the spadix falls away, and the ovaries are left to ripen, surrounded by the shrivelled spathe. The leaves presently fade too, and it is not till the autumn that the swelling fruit bursts its withered cloak and displays a cluster of beautiful bright-red berries, each of which contains usually three seeds. Several points connected with this plant deserve mention. One is the exceedingly poisonous nature of every part of it, a quality shared by many plants of the Order. Again, the leaves merit our attention as furnishing one of the few cases of net-veining in monocotyledonous plants. In most Monocotyledons, as we have seen, the leaf-veins are equal and parallel; but in this plant we find a strong midrib giving out a series of branching veins, such as characterise the leaves of Dicotyledons. Another peculiar feature of *Arum* is the marked production of heat inside the spathe during the period of flowering. This is an effect of **respiration**—the exhalation of carbonic acid and absorption of oxygen, which was mentioned in our first chapter (p. 10). Respiration takes place very actively in germinating seeds and in opening flowers, where great vital activity is displayed. The result of the chemical changes which accompany the process is the production of a certain amount of heat—just as heat is produced by the respiration of animals—and in the *Arum*, where a large number of flowers are carefully screened by the spathe, this production of heat can be easily observed by slipping a small thermometer inside its enclosing mantle.

Here and there among the Anemones and Cuckoo-pints shine the yellow stars of that dearest of all the spring flowers, the **Primrose, Primula acaulis**. Its pale blossoms, set in rosettes of dark-green wrinkled leaves, peer out from every shady nook. Note its creeping stem, knotted with the persistent swollen bases of leaves that have long since passed away. From among them grow the long white roots, like pieces of whipcord, giving off numerous delicate rootlets. The leaves are practically sessile, for the blade is prolonged as a narrow margin down the petiole almost to the root-stock. They are much wrinkled, owing to the veins being placed below the general surface, so that they show as furrows on the upper side of the leaf, as ridges on the under side. The flowers are borne singly on slender round pink peduncles, which are covered with soft white hair. In view of this, the specific name *acaulis*—stemless—appears at first strange, but its suitability is apparent when we examine other species of the genus *Primula*, and find that the flowers are arranged in a terminal umbel, or in whorls, on a leafless common stem or *scape*. In the Primrose the scape is absent, and *acaulis* is descriptive of one of the leading features of the plant. Examine one of the pale yellow blossoms. The calyx is tubular, five-angled, and five-cleft at the top. The corolla is tubular below, expanding above into a flat five-lobed limb. Its tube contains five stamens, their filaments attached to the corolla for the greater portion of their length. It is important to note that the stamens are *opposite the centre of the corolla-lobes*, not alternating with them, as is usually the case in flowers. At the bottom of the tube is seated the globular ovary, and from its top the long slender style rises, crowned with the small club-shaped stigma. Every child knows the curious difference that exists in the appearance of the stamens and pistil in different flowers of the Primrose. This is caused by some flowers having a long style, and the stamens inserted in the tube much below the level of the stigma, while in others the style is short, and the stamens are inserted near the top of the tube. This phenomenon is connected with the cross-fertilisation of the flowers by means of insects, and is an interesting feature to which we shall have occasion to refer later (p. 171). Another British *Primula* is also one of the most familiar and favourite of our spring flowers, the **Cowslip, P. veris.** While the Primrose loves the shade, the Cowslip courts the broad light of day, and especially delights in old pasture-land. In it the characteristic scape is well developed; it bears many shortly-stalked flowers, which have *bell-shaped* calyxes with *short blunt* teeth, and a small *cup-shaped* (not flat) corolla-limb; it differs from the Primrose in the characters which are italicised, as well as in having the leaves *suddenly narrowed below*. The **Oxlip, P. elatior,** a rare plant of Eastern England, is in many respects intermediate between the Primrose and Cowslip, having leaves and scapes like those of the Cowslip, calyx like the Primrose, corolla rather concave like the Cowslip; but it is distinguished from either by the *absence of narrowing and of scale-like folds* at the mouth of the corolla-tube, and in having a *fruit-capsule as long as the calyx*, instead of half as long, as in both the other species. Confusion is apt to arise owing to hybrids which are not unfrequently produced between the Primrose and Cowslip, and which closely resemble the true Oxlip.

The remaining British Primulas, **P. farinosa** and **P. scotica,** are quite different in appearance. They are pretty little plants with smooth leaves, white and mealy beneath, and umbels of purple flowers. *P. farinosa* has the calyx nearly as long as the corolla-tube, corolla-lobes with spaces between them, and capsule twice as long as the calyx. It is confined to the northern counties of England and the Scotch county of Peebles. In *P. scotica* the calyx falls much short of the corolla-tube, the corolla-lobes are broad and have no spaces between, and the capsule is hardly longer than the calyx; it is in Britain found only in the extreme north of Scotland.

We have time for only a hurried glance at the remaining flowers about us. This, one of the handsomest plants in view, with tongue-shaped spotted leaves and a stout spike of striking bright purple flowers, is **Orchis mascula**, the **Early Purple Orchis**, a member of one of the loveliest and most interesting of all the British Natural Orders, the **Orchideæ**. Other Orchids we shall come across in future rambles, and we may safely postpone our examination of this plant till then; but the annexed drawing, which is life-size, of a single flower, well exhibits its strange form, and the variety in size and shape of the purple sepals and petals that compose it.

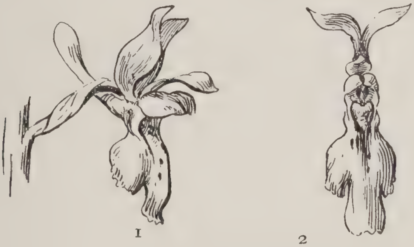


FIG. 10.—FLOWER OF EARLY PURPLE ORCHIS, *O. mascula*. Natural size.

1, side view; 2, front view.

To our right, on the margin of the stream, the **Broad-leaved Garlic**, or Ramsons, **Allium ursinum** (Fig. 11), entirely fills a little hollow with a profusion of shining leaves and starry blossoms. This plant belongs to the large Order **Liliaceæ**, which includes many well-known wild-flowers, such as the Tulip, Fritillary, Asparagus, Solomon's-Seal, Lily-of-the-Valley, Herb-Paris, and Wild Hyacinth, plants very different in appearance, but related as regards their essential characters. Most of the *Liliaceæ* possess bulbous root-stocks, and in this respect *Allium* is no exception; some genera have creeping root-stocks, or *rhizomes*. The flowers of many are handsome, and have for ages been cultivated for their beauty—the Hyacinths, Tulips, and Lilies, for instance. The genus to which the Ramsons belongs cannot lay claim to high distinction in this respect, but as a culinary herb it has a pedigree that stretches into remote antiquity. The whole genus is characterised by a powerful and peculiar odour, which is only too well known to us in Onions and Leeks. The bulbs in our plant are long and tapering. The leaves are radical; in most of the Garlics they are narrow and grass-like, sometimes hollow in the inside; but *A. ursinum*, as one of its English names implies, has comparatively broad leaves, which taper at each end. The slender flower-stem is rather triangular in section, longer than the leaves, and terminates in an umbel of starry white flowers. Below the umbel, and sheathing it when young, is a spathe composed of two membranous leaves. Calyx and corolla are not distinguishable, and the perianth consists of six pointed petal-like leaves, which spread widely, as do the six stamens. The ovary is three-lobed, surmounted by a short style and stigma. The umbels of many species of *Allium* are remarkable as bearing among the flowers sessile bulbils, or little buds, which drop off and forthwith grow into separate plants; but in *A. ursinum* these are absent. Of about a dozen species found in the British Isles (several of which are old kitchen-garden plants run wild), **A. vineale**, the **Crow Garlic,** and **A. oleraceum**, the **Field Garlic,** are the only species besides *A. ursinum* that are at all widely distributed. *A. vineale* is distinguished by its hollow tubular leaves, single bract or spathe tapering to a long point, and heads of few purple flowers with many bulbils among them; it belongs to a section of the genus that has stamens with three points, of which the centre one alone bears an anther. *A. oleraceum* has semicylindrical or flattish nearly solid leaves, all sheathing the stem, spathe of two long pointed membranous leaves, stamens undivided, and a bulbil-bearing umbel of flowers which are greenish streaked with pink.

The formation of small buds or **bulbils**, which are capable of growing directly into separate plants, is not

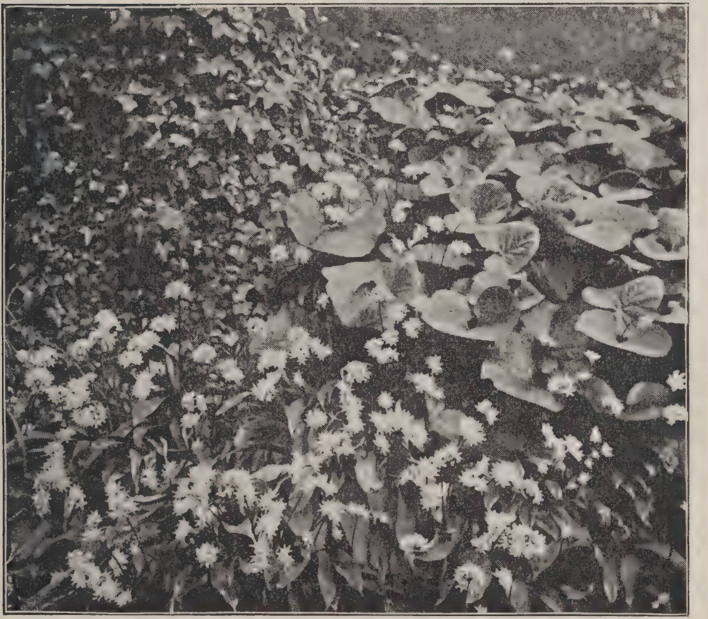


FIG. 11.—BROAD-LEAVED GARLIC AND SWEET-SCENTED BUTTERBUR.

NEAR BELFAST, *May* 1896.

[*Page* 43.

uncommon in nature; such buds are found on species of many Orders, and are borne on various parts of the plant. They may be often found in *Ranunculus Ficaria*, resting like little eggs in the axils of the leaves. In this species they resemble small tubers. In the Coral-root, *Cardamine bulbifera*, they are also axillary, but are clothed with fleshy scales. When they fall off they grow into the knotted rhizomes which characterise the plant. In many of the Garlics, as we have seen, numerous bulbils take the place of flowers. In some common Grasses and Rushes (*e.g.*, *Festuca ovina*, *Juncus supinus*) leafy buds frequently occupy the panicle-branches conspicuously. In other plants again, such as *Cardamine pratensis*, the Lady's-Smock, and *Chelidonium majus*, the Greater Celandine, bulbils are sometimes borne on the surface of the foliage-leaves. In that smallest of British Orchids, *Malaxis paludosa*, tiny bulbils are borne in numbers along the margins of the fleshy leaves. Buds such as these, it is unnecessary to remark, are a great "short cut" in the reproduction of the species. But they have the disadvantage that, being really only shoots of the parent-plant, they give no opportunity for cross-fertilisation and the introduction of new blood, such as the ordinary method of pollen-bearing flowers affords. As a matter of fact, such bulbils are to be found chiefly in plants which, from lack of sufficient fertilisation by insects or other cause, fail to produce a proper quantity of mature and perfect seed.

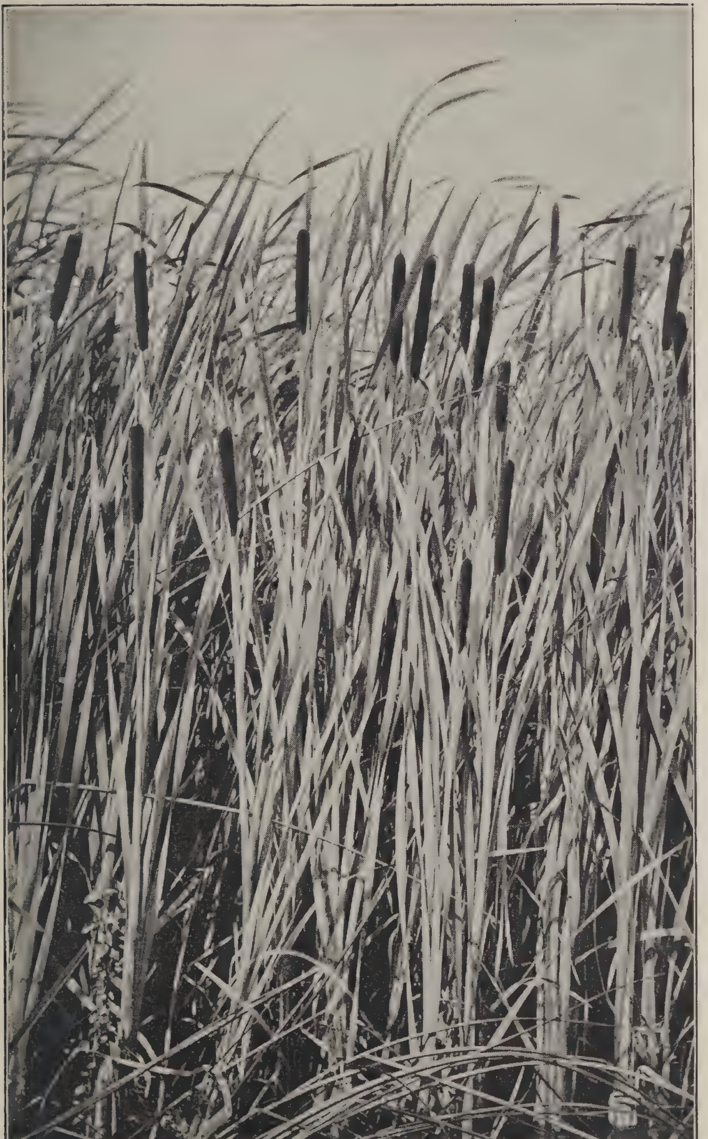
SCENE III

BY THE RIVER

(River Boyne, near Bective Abbey, Co. Meath, *June* 1896.)

> "It was the minstrel's merry month of June;
> Silent and sultry glowed the breezeless noon;
> Along the flowers the bee went murmuring;
> Life in its myriad forms was on the wing,
> Played on the green leaves with the quivering beam,
> Sang from the grove, and sparkled from the stream."
> —Lord Lytton.

It is a blazing day in June. Here in the valley not a breath of air is stirring. The river flows swiftly but silently, rustling the outermost reeds, which catch the current, and answer it by a gentle waving of their slender stems. Beyond the fringe of reeds the surface of the water is broken only by long trailing patches of Pond-weed, and by an occasional eddy, which tells of a sunken rock far below. Down stream, by the ruined mill, the river foams over a weir, on which clumps of Bullrushes and Water-Dropwort have established themselves, and dispute the passage. Beyond we get a glimpse of the old bridge that spans the Boyne in many arches. The cattle have congregated here, and stand deep in the water in the welcome shade of the stonework, lazily munching, and flicking away the flies. Up the river the marshy margin on which we stand gives way to firmer, drier ground, where tall trees rise on either bank, and cast deep shadows on the quivering stream. At our feet the reed-fringed margin is broken by a small but deep inlet, where the sunshine streams through the clear brown water and lights up the bottom six feet below. In this calm haven many plants find a secure home; the margin is occupied by tall marsh-plants, the water is full of aquatic species. A better spot for the study of the river flora could not be desired. What strikes us most about the riparian or river-bank flora is the abundance of plants of tall, narrow-leaved habit. Iris,



BROAD-LEAVED REED-MACE (*Typha latifolia*).

By the River Boyne at Bective, *June* 1896.

Plate I.]

Bur-reed, Sweet Flag, Bullrushes, Reeds, Blackheads, all have very tall, narrow, unbranched leaves or stems. When we think over this, we realise that such plants have a distinct advantage here over lower broad-leaved species. They offer very little resistance to the water, and are, for that reason, less likely to be injured by floods; and, in consequence of their great height, changes of level of the water will not hamper their operations of assimilation in the atmosphere. Buoyancy and elastic strength are also highly desirable under the conditions of this semi-aquatic life, and we find these qualities remarkably developed in the river-side plants, by means of tough fibres in the outer part of the plant-structures, and very large air-filled cells or tubular cavities within. "I bend, but I do not break," is indeed well applied to the Reed; and we have all in our time made rafts of bundles of buoyant Bullrushes. On the marshy bank, just beyond danger of inundation (at least, during the summer, when their foliage is developed), large-leaved plants are numerous; great Docks are here, and the gigantic Butter-Bur, and the large tripinnate leaves and white umbels of the Wild Angelica. In the water, plants of another group grow—thoroughly aquatic species, which are chiefly or entirely submerged, such as Pond-weeds, Milfoils, and Water-Starworts. These are rooted to the bottom, and have narrow leaves, in some reduced to hair-like segments. When the stems reach the surface the shape of the leaves frequently changes; they become broad and herbaceous, and float on the top of the water. There are still other plants which do not attach themselves to the ground at all, but send out roots which hang downward in the water, and the plants float on the surface, or rest on the bottom, such as the Frog-bit and Duckweeds; and a few others, such as the Bladderworts, have dispensed with roots altogether. Examples of these various habits of growth we shall examine presently; let us first study the aërial vegetation of the margin. On the swampy springy flat that fringes the river, tall plants rise out of a dense undergrowth of Grasses and Sedges. This species, crowned with pyramids of pretty yellow flowers, is the **Yellow Loosestrife, Lysimachia vulgaris**. The tall stems rise singly from the creeping rhizome. They are erect, and unbranched except near the top, and bear numerous acute ovate leaves, generally arranged in threes. The structure of the flower at once recalls that of the Primrose, which we recently examined. The calyx and corolla are each deeply cleft into five segments. The five stamens are inserted on the corolla, opposite to its segments. The ovary is superior, globular, surmounted by a straight slender style, and the seeds are borne on a globular receptacle or *placenta*, which rises in the centre of the one-celled ovary. These characters all fit the Natural Order *Primulaceæ*, to which we correctly refer the plant. The flower differs from that of *Primula* in the shape of the corolla especially, which diverges from the base into a widely-open bell, instead of having a tube below and a flat limb above. Two other species of *Lysimachia* are not uncommon. Both differ in habit from *L. vulgaris*, being small and prostrate. **L. nemorum**, the **Yellow Pimpernel**, is a common little woodland plant, with decumbent stems bearing opposite pairs of egg-shaped pointed leaves on short stalks, and yellow axillary flowers on slender peduncles longer than the leaves; the sepals are very narrow. **L. Nummularia**, the **Moneywort**, has long trailing stems, with many opposite pairs of roundish, almost sessile shining leaves, and large shortly-stalked axillary yellow flowers, with large sepals, broad and heart-shaped at the base.

With the Yellow Loosestrife grows the **Great Water-Dock, Rumex Hydrolapathum**, easily known among the many species of Dock by its tall erect flat leaves, which taper at each end. The leaves are often a yard in height, and a large plant of this species, with several branched flower-stems rising five or six feet from among its tall foliage, forms a striking and handsome object. Examine the flowers of this plant. They are very small, and green in colour. The perianth consists of two whorls, which may be fairly called sepals and petals. The three sepals are small and acute; the three petals larger and triangular, and, as in other species of Dock, they grow considerably after the flowering-time, and remain as a kind of envelope round the fruit. Each of the petals is furnished with a curious reddish corky tubercle on its back. The stamens are six, arranged in three pairs. From the ovary rise three divergent styles, each bearing a feathery stigma. The ovary is one-celled, and contains a single ovule, which matures into a little three-sided nut. The Docks belong to the **Polygonaceæ**, the British representatives of which are a dozen or so of Docks, the same number of Knot-grasses (*Polygonum*), and the Mountain-Sorrel (*Oxyria*). With the Docks we are all familiar; several are common and troublesome weeds, and on account of their general resemblance, some of them are rather difficult to determine. The **Common** and **Lesser Sorrel, R. Acetosa** and **R. Acetosella**, differ from the other Docks in having leaves arrowhead-shaped (*sagittate*) at the base, and a pleasant acid flavour. The Knot-grasses are also common plants, and very familiar weeds. The perianth is in one whorl, and is coloured, so that in some species, such as the **Bistort, P. Bistorta**, and **P. amphibium**, a pretty flower is the result. The bracts take the form of rather conspicuous membranous fringed collars (*ocreæ*), which encircle the stem at the base of each leaf-stalk. The Knot-grasses are plants of varied appearance. **P. Convolvulus** well deserves its name; in its twining habit and sagittate leaves it mimics the Bindweeds very closely, but its small greenish flowers are widely different from the beautiful trumpets of the Convolvulus. **P. amphibium** leads a truly amphibious life, and flourishes equally on the top of a bank, where it sends up erect leafy stems, generally devoid of flowers, or in ten feet of water, where its long lax stems reach up to the surface, and there produce broad leathery floating leaves, and dense spikes of pretty rose-coloured blossoms. **P. viviparum** is confined to mountainous regions, and differs from all the others in bearing small red bulbils among the flowers. **P. Raii** and **P. maritimum** grow on the sandy sea-shore (the latter found in Hampshire only), and resemble the common **P. aviculare**, but their leaves are very smooth and bluish (*glaucous*) and leathery, like those of so many sea-shore plants, and the nut is longer than the perianth. **P. aviculare, P. hydropiper (Water-Pepper), P. Persicaria (Spotted Persicaria)**, and **P. lapathifolium** are common plants, the first on waste ground, the second in ditches, the others on cultivated lands. **P. Bistorta**, the **Snake-weed**, has subterranean creeping stems, with enlarged tuberous branches bent into the shape of a letter S, whence it derives its English name. The leaves are ovate and almost cordate at the base; the unbranched flower-stems bear dense cylindrical spikes of pink blossoms. The **Mountain-Sorrel, Oxyria digyna**, is a plant of alpine rocks, with roundish succulent leaves and short compound panicles of flowers resembling those of the Common Sorrel.

Another tall plant that grows in the marsh is **Thalictrum flavum**, the **Yellow Meadow-Rue**, which, it will be remembered, was mentioned in the second chapter as an example of a Ranunculaceous species with no petals and small petaloid sepals. The erect branched stem bears pretty bipinnate leaves, each leaflet divided into three wedge-shaped segments more or less toothed. The flowers are borne in terminal panicles, and are rendered showy by their numerous large yellow stamens, compared to which the calyx and group of Buttercup-like carpels are inconspicuous. Several other Meadow-Rues are found in Britain. *T. alpinum* is a tiny inhabitant of high mountains, which we shall meet with presently (p. 213). The others are bushy plants with very prettily-cut leaves, which recall the fronds of the Maidenhair Fern, and widely-spreading panicles of flowers. The differences between them are not easily diagnosed.

Let us now turn to the fringe of luxuriant vegetation that marks the margin of the river. This is largely composed of narrow-leaved monocotyledonous plants, but a few Dicotyledons are here too. The **Greater Spearwort, Ranunculus Lingua**, for instance, is abundant. This is the largest British Buttercup, and belongs to a section of *Ranunculus* which has lance-shaped leaves. The plant before us has a tall, stout, rather zigzag hollow stem, which bears narrow tapering sessile glaucous leaves; the branches of the stem terminate in large deep yellow flowers. Note the veining of the leaves, which closely resembles the parallel veining of certain monocotyledonous plants. Closely related to *R. Lingua* is **R. Flammula, Lesser Spearwort**, a smaller plant with shortly-stalked leaves, stem reclining at the base and rooting, and fruit destitute of a wing, while that of *R. Lingua* is furnished with a narrow wing prolonged into a beak at the apex. *R. Flammula* is a variable plant, sometimes broad-leaved, sometimes very narrow-leaved; sometimes several feet high, sometimes creeping along the ground, with tiny leaves and flowers, and rooting at the joints. **R. reptans**, which is found on the shores of Loch Leven in Kinross-shire, is by some botanists considered an extreme form of this small creeping variety; by others it is reckoned sufficiently distinct to hold specific rank. **R. petiolaris**, recently described and named by Rev. E. S. Marshall,[1] is a plant likewise allied to *R. Flammula*, with erect flower-stems and numerous curious root-leaves, which are reduced to short petioles; it grows on the margins of several Highland lakes.

In one spot the floating rhizomes of the **Bog-Bean, Menyanthes trifoliata**, growing out from the bank, form a thick mat, from which rise the numerous ternate leaves and upright fruit-stalks; a few late flowers also still linger. This is a member of the Gentian tribe that has taken to a semi-aquatic existence, and the only British representative that has divided leaves. The plant is a striking one, and easily known by its smooth leaves of three equal egg-shaped leaflets, and raceme of very beautiful white flowers tinged with pink on the outside, and remarkable for the dense white woolly hairs which clothe the inner faces of the corolla-lobes. The fruit is a globose one-celled capsule, containing numerous seeds. Another member of the *Gentianeæ* differs still more from the typical Gentians and Centaurys; this is **Limnanthemum peltatum**, or **Water-Villarsia**, which is a thorough aquatic, and mimics the Water-Lily in appearance. It has roundish deeply cordate floating leaves and pretty yellow flowers, the five-parted corolla fringed round the margin, and bearded near the base. The fruit is flask-shaped, in which respect the plant offers another point of resemblance to the Yellow Water-Lily. It is a rare plant, and is truly native in England only.

Among the Bog-Bean rise the remarkable leaves and pretty flowers of the **Arrow-head, Sagittaria sagittifolia.** The root-stock consists of a bulb which gives off shoots buried in the mud at the bottom; each shoot ends in a similar bulb, which produces a new plant in the following season. Note the development of the leaves. The earliest ones are submerged and linear, and consist, in fact, of petioles only. Then follow longer linear leaves, the upper part of which floats on the surface. Next floating leaves with a distinct lamina, egg-shaped with long sagittate lobes below, are produced; and finally the mature leaves, triangular and deeply sagittate (see Fig. 12), which rise out of the water and stand almost vertically. A similar change of shape may be noticed in many aquatic plants with floating leaves. When the leaves do not reach the surface, no flat blade is produced—for the very good reason, no doubt, that under such circumstances a blade would be of little use. The flowers of the Arrow-head are very pretty. They are borne in whorls of three on an upright stem; the lower flowers are female, the upper male. The perianth is distinctly differentiated into calyx

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[1] *Journal of Botany*, xxx. p. 289 (1892).

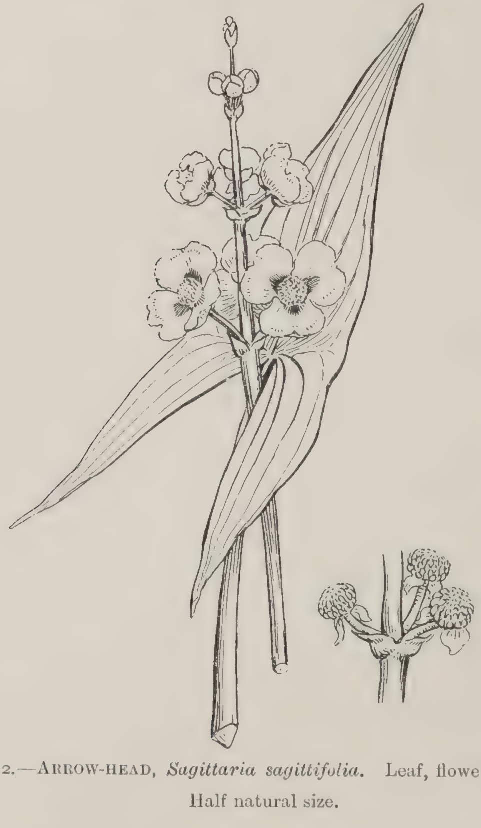

Fig. 12.—Arrow-head, *Sagittaria sagittifolia*. Leaf, flower, and fruit. Half natural size.

and corolla. The three sepals are small and green; the three petals large, pure white, and beautifully delicate, with a deep purple spot at the base of each. In the male flowers the centre is occupied by a profusion of stamens; in the female by a globular mass of one-celled and one-seeded carpels, thickly set on a common receptacle, recalling the similar arrangement which is found in *Ranunculus*. *Sagittaria* belongs to the Order **Alismaceæ**. A species of the genus **Alisma**, from which the Order derives its name, grows here with the Arrow-head; it is **A. Plantago-aquatica**, the **Greater Water-Plantain**. This is a well-known plant of ditches and pools. The root-stock is bulb-like, but without scale-leaves (a *corm*), and from it numerous leaves rise above the surface, a few of them submerged or floating, and in this case modified as has been described in *Sagittaria*. The blade is large and broad, tapering to a point above, abruptly contracted or tapering below. The leaves of both this plant and of *Sagittaria* furnish remarkable examples of the "parallel" veining so characteristic of Monocotyledons. In the narrow leaves of Grasses, Sedges, Iris, &c., where the margins are almost mathematically parallel, at least for a portion of their length, the veins are likewise nearly parallel; but in broader leaves, such as those we are now examining, the word *parallel* is used in a different sense, and signifies a series of lines which maintain a proportionate distance between the central vein and the margin of the leaf (see Figs. 12 and 15). The inflorescence of *Alisma Plantago-aquatica* consists of a very large much-branched compound panicle, bearing numbers of small white flowers, like small *Sagittaria* flowers, but that each is perfect, having a ring of stamens surrounding a simple ring of carpels. One other species of *Alisma* inhabits our Islands. **A. ranunculoides** is a common plant in marshes and shallow pools. It is a much smaller plant than *A. Plantago-aquatica*, with narrow leaves and flowers in umbel-like clusters. The many carpels are arranged in globular heads, which immediately recall those of *Ranunculus*, and from this resemblance the plant derives its specific name. Closely allied to *Alisma*, and by some botanists placed in that genus, is **Elisma natans**, a rare lake plant with small oblong floating leaves and comparatively large white flowers, which closely resemble those of *Alisma*, except that they are borne on long simple peduncles which arise from the nodes of the stem, from which points the leaves and roots also spring. The other two British plants belonging to the *Alismaceæ* may also be mentioned here, that our survey of the Order may be complete. Like the others, they are aquatic species, and each is the sole British representative of its genus. **Butomus umbellatus**, the beautiful **Flowering Rush**, is deservedly a favourite plant. From the stout creeping submerged root-stock rise numerous linear three-sided leaves several feet in height, and tall round scapes, bearing each a terminal many-flowered umbel of pretty rose-coloured blossoms. The six segments of the perianth are all coloured similarly, and of nearly equal size. The red stamens are nine in number, and the six red carpels cohere in their lower part. As in many cases, the English name is misleading, for this plant is not a Rush, nor is it related to that genus. The last representative of *Alismaceæ* is **Damasonium stellatum**, the **Star-fruit**, a rare South of England plant, with a general resemblance to *Alisma*, but a strikingly different fruit, from which it takes its specific name and its English name also. The fruit consists of six pointed carpels, which spread horizontally, so as to resemble a six-rayed star. The leaves are oblong, floating or rising out of the water; the flowers are borne in one or two whorls on a short stout stem.

Let us next examine the tall narrow-leaved plants that form the conspicuous fringe of vegetation along the edge of the river. Several of these have very similar sword-shaped leaves, yet belong to different Orders. Such are the **Yellow Flag (Iris Pseud-Acorus**, Order *Irideæ*), the **Branched Bur-Reed** (**Sparganium ramosum**, Order *Typhaceæ*), and the **Sweet Flag** (**Acorus Calamus**, Order *Aroideæ*). But even by their leaves they may be easily distinguished. The Bur-reed leaves are narrower than the others, flat, and three-sided at the base, owing to the thickening of the central portion of the back; and the leaves are attached to the root-stock in no particular order. Both the others have broader leaves, which are *conduplicate*—that is, they are folded together down the centre from top to base, so that the margins are brought into contact, and the apparent two sides of the leaf are really the two halves of the under side, the true upper side being enclosed. In the upper portion of the leaf the two original edges are fused together, but towards the base they separate, and clasp the younger leaves of the flattened shoot, which bears its folded leaves alternately in two opposite rows. The leaves of the Sweet Flag are narrower and brighter green than those of the Yellow Flag, and can be distinguished by the powerful sweet aromatic odour when bruised, and by being crimped along the margin. The flowers of these three plants are utterly different, and at once show how widely separated they are. The Bur-Reed has globular heads of sessile flowers, arranged in a branched raceme. The lower heads consist of flask-shaped pistils only, with rather long styles, giving the heads the appearance of green prickly balls. The upper heads are soft yellow balls of stamens. The Sweet Flag has the flower-stems flattened so that they resemble the leaves. The part that corresponds to the spathe of *Arum* is also long and leafy, and looks like a continuation of the stem; so that the dense conical spike of small sessile flowers, in reality terminal, appears as a finger-shaped projection on the side of the leaf-like stem. In the Yellow Flag the flowers are too well known to render it necessary to point out the wide differences which separate this plant from both of the above; but we shall have occasion to return to their structure immediately.

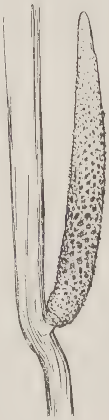

FIG. 13. FLOWER-SPIKE OF SWEET FLAG, *Acorus calamus*. Half natural size.

We must now go back to the three plants we have been comparing, and shortly consider them with relation to their nearest allies. The Bur-Reed, as already stated, belongs to the Order **Typhaceæ**, which derives its name from *Typha*, the well-known Reed-mace, the typical genus; and in the British Isles the Order is represented by these two genera only. Of **Sparganium** we have four species. **S. ramosum** is the largest, and is well distinguished by its flower-stem being branched near the top; the branches are given off alternately on each side; each has a large leafy bract, and bears several heads of flowers. **S. neglectum,** recently described as a new species by Mr. W. H. Beeby,[1] is exceedingly like *S. ramosum*, of which it may be a variety. **S. simplex** is in growth like *S. ramosum*, but, as its name implies, the flower-stem is *simple*, not branched, and bears several alternate heads, of which the lower fertile ones are shortly stalked, the upper barren ones sessile. Sometimes the leaves are all floating, when it is liable to be mistaken for the next species, **S. affine** (= *natans*), which has very long floating leaves, and a flower-stem that just rises above the surface of the rather deep water in which it grows. The points by which *S. affine* may be distinguished from floating forms of *S. simplex* are not conspicuous. In *S. affine* the leaves are dilated and sheathing at the base; in *S. simplex* they are trigonous (three-sided), with a conspicuous keel on the back; and *S. affine* has a flattened tongue-shaped stigma, while in *S. simplex* the stigma is narrow and pointed. The fourth species is **S. minimum,** a small plant with several sessile or very shortly stalked female heads, and usually a single terminal male head; the fruit differs from that of *S. affine* by being quite sessile, egg-shaped, broadest at the top, with a short narrow point (the persistent stigma), while *S. affine* has an oblong fruit tapering at one end into a short stalk, at the other into a rather long point which bears the tongue-shaped stigma.

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[1] *Journal of Botany*, xxiii. p. 193 (1885).

The other British genus of *Typhaceæ* is quite unlike *Sparganium.* The **Reed-mace**, or Cat's-tail, **Typha,** sometimes named Bullrush, is a well-known plant, and one of the handsomest members of the river flora. The stem creeps in the mud, and sends up strong shoots which produce a number of erect linear leaves, five to ten feet high, and equally tall unbranched flower-stems, which bear at their summit a long cylindrical mass of female flowers, and above them a similar mass of male flowers. The female flowers consist of a very small stalked ovary with a long stigma, each ovary surrounded by a ring of delicate hairs; the male flowers consist of groups of stamens also surrounded by hairs. Two species are found in our Islands. **T. latifolia** is a common plant, with glaucous leaves an inch across and stout spikes, which in fruit are an inch in diameter. The male spike succeeds the female without any space of bare stem between. **T. angustifolia** is rarer, and has greener, narrower leaves, about half-an-inch wide, and rounded on the under side. The flower-spikes are much narrower, only about half-an-inch across, and there is an interval between the top of the female flowers and the bottom of the male.

On their first appearance from among the sheathing leaves, the flower-spikes are carefully wrapped in long membranous bracts, delicate as the tissue-paper in which we might enclose articles of value; these drop off as growth progresses.

The brown fruit-spikes of the Reed-mace persist during the winter, but at length the tightly-packed fruit becomes detached from the central stem, and owing to the expansive pressure of the hairs, it fluffs out into downy masses, in bulk many hundred times greater than the spike from which it comes. Each fruit consists of a very small brown seed, tapering at the upper end into an extremely slender thread (the withered style and stigma), and at the other into an equally delicate stalk, on which are borne numerous pale brown hairs, which, now that they have room, spread widely, and act as wings to waft the seed far and wide. According to a rough estimate that I made, about a quarter of a million of these flying seeds are borne on a single head of average size.

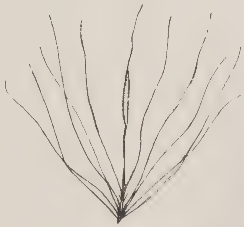

FIG. 14.—FRUIT OF REED-MACE, *Typha latifolia*. Twice natural size.

Next we pluck a flower of the **Yellow Flag**. Its structure is curious and beautiful. The three outer perianth-segments or sepals are large and bright yellow, and bend outwards and downwards. The three inner, or petals, are much smaller and narrower, and stand up vertically between them. The three stamens are concealed by the three large yellow petal-like segments of the style, which arch over the stamens and lie close to the sepals, and terminate each in two upright fringed lobes. The inferior ovary is three-celled, and ripens into a large three-sided capsule, which opens along its three angles, disclosing three tightly-packed rows of flattish seeds. The only other native British species is **Iris fœtidissima**, a plant of bushy places, with dark green shining flat leaves, which emit a strong peculiar odour when bruised. The flowers are blue, narrower in all parts than those of *I. Pseud-Acorus;* the seeds are bright orange and berry-like, and look extremely pretty as the capsule-segments curl backward and expose them to view.

One other of the tall river-margin plants we must examine. This is the **Bullrush, Scirpus lacustris**. It belongs to the **Cyperaceæ**, that large and important Order which includes the Twig-rush, Cotton-grass, and the numerous Sedges. But, unlike many of its allies, it is a leafless plant. Its tall, smooth, round stems rise six or eight feet, bare except for one or two sheaths at the base. That it has not altogether lost the power of bearing leaves, however, is shown by a peculiar state which it sometimes assumes when growing in running water, when long narrow floating or submerged leaves are produced. Normally, however, leaves are absent, and the mat of interlacing creeping rhizomes in the mud sends up a thick grove of tall graceful stems, which bear a terminal tuft of small brownish flowers, subtended by a few bracts. The flowers are borne on short tassel-like spikes. In structure they are somewhat like those of Grasses. Each flower springs from the axil of a scaly bract or *glume*. The perianth is represented by a number of small bristles. There are three stamens and an egg-shaped ovary containing a single ovule. The style is long and slender, and bears two or three spreading stigmas. The fruit is a little brown roundish nut, with a beak which is the swollen base of the style. The brown glumes which bear the flowers in their axils are placed close together and overlapping, so that an egg-shaped spike is produced. The stems are dark green and shining; inside the thick outer coat the central portion is filled with loose dry cellular tissue or pith. There are nearly a dozen and a half species of *Scirpus* native to the British Isles. Some are plants nearly as large as *S. lacustris*, others tiny species only a few inches high; some possess abundant grass-like leaves, others are leafless; almost all are inhabitants of wet ground, as, indeed, are the majority of the plants of the Order.

It is now time for us to examine the floating and submerged members of the river flora. This we may do with great advantage in the deep, still inlet near us. Of true **hydrophytes,** or plants which spend their whole existence below the surface, there are four examples here—a Water-Crowfoot (*Ranunculus*), Water-Milfoil (*Myriophyllum alterniflorum*), Canadian Weed or Water-Thyme (*Elodea canadensis*), and a Pond-weed (*Potamogeton*). We are struck with the finely-cut leaves of the *Ranunculus* and *Myriophyllum*, which are divided into numerous hair-like segments. The leaves of the Pond-weed are lanceolate, and very thin and delicate; like those of the other two plants, they dry up and fade after a few minutes' exposure to the hot sun, even if we place the ends of the stems in water. These three plants have their leaves coloured brownish; the Canadian Weed is the only one of the four which has a distinctly green colour. Another point to notice is the weakness of the stems and leaves when removed from the water; they are quite unable to support themselves, and hang helplessly in our hands. Note also the whitish coating of carbonate of lime with which the Milfoil and Pond-weed are encrusted. These differences between hydrophytes and aërial plants are effects of their altered mode of life, due to the different circumstances in which they are placed. In aërial plants the whole water-supply is usually provided by the roots, and an elaborate system of distribution is developed to prevent any portion of the plant suffering by reason of any excess of evaporation of moisture, such as is continually going on from its surface. In plants which are immersed in water this is not required, and each portion of the plant takes in directly what water it needs. Hence the fading of a shoot if we place only the cut end in water, for there is no arrangement, as in aërial plants, for the rapid transport of water along the stem. The supply of carbonic acid has also to be taken from the water, in which a small quantity is always present in solution. Many hydrophytes obtain portion at least of their carbonic acid supply from the bicarbonate of lime which water almost always contains, and which gives it the property of *hardness*. The plant absorbs carbonic acid from this salt, and the insoluble carbonate of lime is left behind, and remains as a limy coat on the surface of the plant. The cause of the lax and flaccid character of their stems is not difficult to explain. Aërial plants have to grow upward to obtain light and air, and woody tissue and tough fibres are developed to produce stems of sufficient strength to support the weight of the upper portion of the plant, not only in calm, but also in storm. Plants which live in water are buoyed up by the surrounding medium, and their stems are actually in tension instead of in compression; there is no need for stiffening, and pliability is, indeed, a distinct advantage, enabling the plant the more readily to adapt itself to changes of current or of water-level. In these hydrophytes the root acts as an anchor rather than as an organ of nutrition; and we find, indeed, that certain species which frequent calm ponds and ditches do not anchor themselves to the bottom at all, but drift about with roots hanging down in the water, like the Ivy-leaved Duckweed (*Lemna trisulca*). Others have dispensed with roots altogether, such as the Bladderwort (*Utricularia*). The true hydrophytes graduate imperceptibly into plants which possess floating leaves, the upper surface of which is in contact with the atmosphere. These floating leaves have a thick and leathery texture compared with the membranous submerged leaves, for they are liable to a good deal of rough usage by waves and wind and rain. In most plants the stomata, or small openings through which atmospheric gases are absorbed, are situated on the under side of the leaf. It is interesting to find that in these floating leaves they are developed in great numbers on the upper side, and are entirely absent below, where they would be of no use. Indeed, the plant appears to utilise to the utmost its opportunities for obtaining an atmospheric food-supply. Kerner von Marilaun[1] states that there are about 11½ *millions* of stomata upon the upper side of a Water-Lily leaf of ordinary size! To fulfil their function properly, the stomata must not get choked with water; and the surfaces of floating leaves provide for this, being of such a nature that water will not lie on them, but collects in little globules which soon escape. Another point to be noticed about these floating leaves is the purple colour which the under side frequently assumes. The Frog-bit, which grows in the pool at our feet, exhibits this character; the upper side of each leaf is green, the under side deep purple. The same may be seen in the leaves of the White Water-Lily (*Castalia speciosa*), and in the fronds of the Greater Duckweed (*Lemna polyrrhiza*). The leaves of many terrestrial plants, especially such as are placed close to the ground, are similarly coloured. The cause of the purple hue is the presence of a substance called **anthocyanin,** and it appears to play an important and peculiar part in the economy of plant life. It possesses the property of converting light-rays into others which have a high heating power. The light that falls on a floating leaf is first required by the chlorophyll, to aid the decomposition of carbonic acid and the formation of carbohydrates. Whatever light is not absorbed, and passes through the leaf, is captured by the anthocyanin, on the under surface, and converted into heat, which assists the functions of the leaf.

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[1] "Natural History of Plants," i. p. 288.

The plants with floating leaves again merge into others with leaves rising above the water; and in some species we can find all three gradations—the brown membranous submerged leaf, with no stomata; the thicker floating leaf, with a green upper surface crowded with stomata, and a purple under surface on which stomata are absent; and the aërial leaf, green on both sides, and with stomata on both sides, or on the under surface only.

Let us return to the **hydrophytes**, or completely-submerged plants of our pool. The **Ranunculus** is one of the very difficult section of that genus which have an aquatic habitat. All of this section possess long flaccid stems, leaves divided into capillary segments, and pretty white flowers with a centre of yellow stamens. Many of them produce on the upper portions of the stem floating leaves, which are lobed like an Ivy-leaf, or cut into three distinct leaflets. The blossom rises above the water, but after flowering the peduncle curves downwards, and the fruit is ripened below the surface. These Water-Crowfoots are generally distributed in streams, lakes, and pools. A number of species have been described, all of which are puzzlingly alike. They appear at first sight very different from the Buttercups of our meadows, but the structure of the flower is essentially the same, and we find several connecting links in *R. hederaceus*, *R. Lenormandi*, and *R. sceleratus*. The first two inhabit muddy places.

They are small creeping plants, with little white flowers, and leaves very like the floating leaves of some of the aquatic group, but the capillary submerged leaves are absent. *R. sceleratus* lives in marshes and shallow pools. It has smooth lobed leaves like the foregoing, but larger; the stem is erect and branched, the flowers small and yellow. This leads us to *R. Flammula* and *R. Lingua*, the tall-growing river-side plants which we lately examined, and thence we pass through *R. Ficaria* to the familiar Buttercups.

The **Milfoil**, which we next fish out of the water, is a pretty plant, with a long stem bearing an abundance of brownish pinnatifid capillary leaves arranged in whorls; the stem terminates in a short spike of minute blossoms. Three species of Milfoil inhabit our lakes and streams, and, though like each other, possess points of difference which may be easily grasped. **Myriophyllum verticillatum** is the largest and rarest of the three. The flower-spike is long, all the flowers are in axillary whorls, and are subtended by pinnatifid bracts. **M. spicatum** has the flowers in a leafless spike, and the bracts small and entire; the spike is erect when in bud. **M. alterniflorum**, the plant which grows in the pool beside us, is the smallest of the three, but there is no great difference of size. The female flowers are borne at the base of the spike in axillary whorls, the male ones alternate or opposite, on a short leafless spike; the spike is hooked when in bud. All three species have unisexual flowers — that is, the male and female organs are borne in separate flowers, but both kinds of flowers are found on the same plant.

The **Canadian Weed** or Water-Thyme, **Elodea canadensis**, which grows so abundantly in a corner of our pool, and appears so thoroughly at home, is in reality a recent immigrant. It is a native of North America, and the story of its invasion of Europe is indeed remarkable. Its first appearance seems to have been about the year 1836, when it was found in the pond at Waringstown, Co. Down, after some aquatics had been planted there, with which it may have been introduced.[1] In 1842 it was noticed in a pond at Duns Castle, Berwickshire.[1] Three or four years later it turns up in the canal basin at Foxton, Leicestershire, having presumably been introduced with timber from North America.[2] It appears in Belgium and Silesia in 1860, in Holland in 1861, in France in 1867, Poland in 1879, and is now found as far east as Moscow on the north, and Vasvar, in Hungary, on the south.[3] After its introduction to these Islands, it increased and spread with amazing rapidity, choking up rivers and canals with dense masses of vegetation, and creating for a while quite a panic among water-men throughout the country. Writing in 1869,[4] Mrs. Lankester gives a graphic description of its invasion of the Cambridge district, and of the serious inconvenience it was then causing to rowing-men, who christened it *Babingtonia pestifera*, erroneously attributing to the late Professor Babington the doubtful honour of having introduced it into that district. However, the plague has passed away of its own accord, and although *Elodea* is now to be found in almost every part of our Islands, it appears to have abated the inconvenient vigour of its growth. One interesting point must be noticed. Until lately the female plant (the species is diœcious) alone was known in Britain; its rapid spread was due not to seed, but to the brittleness of its stems, and the fact that every joint will send out roots and buds, and grow into a fresh plant. The flowers are borne on extremely long and slender peduncles, and are exceedingly small and of a lilac hue; they float on the surface of the water like specks of purplish dust. The plant belongs to the *Hydrocharideæ*, of which we shall examine another representative immediately.

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[1] Professor Oliver states ("Lessons in Elementary Botany," p. 228, 1895) that the plant was first remarked in Britain in 1817.

The brown membranous-leaved **Pond-weed** is one of a numerous and difficult group, and in the absence of fruit (it is at present not yet in flower) it would be rash to attempt to name it; but close by grow two other Pond-weeds with more distinct characters, which we can safely identify. They are **Potamogeton natans** and **P. pusillus**. These represent the two extremes of the British series,

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[1] Dickie, "Phytologist," v. p. 88 (1854).
[2] "English Botany," ix. p. 81 (1869).
[3] Nyman, "Conspectus Floræ Europææ," Suppl. ii. (1889–90).
[4] "English Botany," ix. pp. 82–85.

and we may therefore study them with advantage. The broad oval floating leaves of *P. natans* are a familiar feature of pond-life. They are produced alternately on shoots that spring from the far-creeping rhizome in the mud at the bottom. The leaves which do not reach the surface consist of linear petioles only; these rapidly change into broadly oval leathery floating leaves when the surface is attained. All the leaves have long, pointed membranous stipules. The inflorescence, as in all the other Pond-weeds, is borne in a dense leafless spike, which rises above the surface when in flower. The flowers are small and greenish. Each has a perianth of four green leaf-like segments, surrounding four short stamens and an ovary of four separate one-celled carpels with short stigmas. *P. pusillus,* on the other hand, is an exceedingly slender submerged plant, with branching stems almost as thin as thread, very narrow linear leaves an inch or so in length, and small roundish heads of flowers; it usually grows in dense masses. Between these two extremes — the broad-leaved floating *P. natans* and the exceedingly narrow-leaved submerged *P. pusillus*—many intermediate species are found. Some produce both submerged and floating leaves, the latter usually broader, thicker, and greener than the former, but in *P. coloratus* very broad leaves are borne entirely under water, and the narrow grassy leaves of *P. obtusifolius* often float. An instructive example of change in the shape of leaves, on account of change of condition, is shown by the specimen of *P. natans* sketched in Fig. 15, collected in a friend's garden in October 1895. The plant

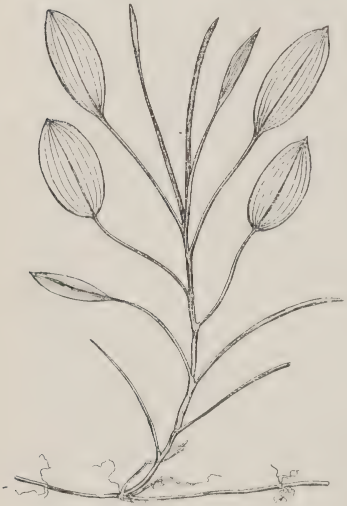

FIG. 15.—FLOATING PONDWEED, *Potamogeton natans.*

Linear leaves at base of the shoot, expanded leaves in the centre, linear leaves at the top. One-fourth natural size.

sent up a shoot which, as usual, produced first bare petioles and then broad floating leaves. Autumn rains then raised the level of the pond some nine inches, totally submerging the plant; the leaves produced now became narrower, and, the rise of water continuing, once again assumed the form of linear petioles.

Of plants whose leaves all float on the surface of the water, there are several in our pool—the **Yellow Water-Lily, Nymphæa lutea**; the **Frog-bit, Hydrocharis Morsus-ranæ**; the **Lesser Duckweed, Lemna minor.** The **Frog-bit** at once attracts our attention by its pretty clusters of heart-shaped leaves and beautifully-delicate white flowers. This plant grows like an aquatic Strawberry, sending out long runners which emit at intervals tufts of floating leaves above, and roots hanging in the water below. In the autumn, buds form at the ends of the shoots, and while the rest of the plant decays, these sink to the bottom and rest there secure till the following spring, when they rise to the surface and grow into new plants. Examine the blossoms. In their three small green sepals and equal number of delicate white petals they remind us of those of *Alisma* and *Sagittaria.* Like *Sagittaria*, too, they are unisexual. The male or staminiferous flowers are borne

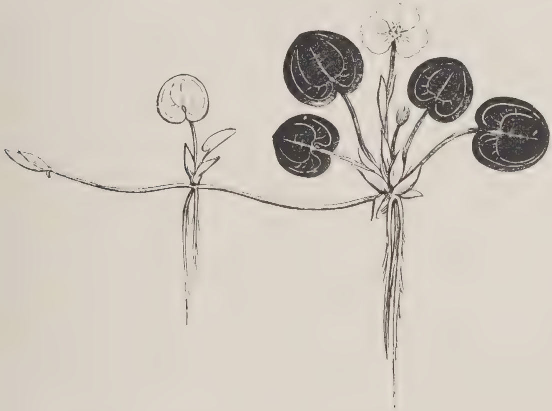

FIG. 16.—FROG-BIT, *Hydrocharis Morsus-ranæ.*
One-third natural size.

in umbellate clusters of about three; the umbels have an involucre of several large membranous bracts. The female or pistilliferous flowers rise singly on longer stalks. The bases of their peduncles and of the leaves bear similar membranous sheaths. Fruit appears to be very rarely perfected. Its production is not essential to the plant's continued existence, as its far-creeping habit, its production of numerous free winter buds, and its bulbiferous roots, furnish it with ample means of multiplying and spreading.

Two of those curious little plants, the **Duckweeds,** are here. That very common species, **Lemna minor, Lesser Duckweed,** floats about in the corners, and the **Ivy-leaved Duckweed, L. trisulca,** lurks among the rotten vegetation on the bottom, and on the surface as well. These are plants of anomalous habit. Stem and leaf are not distinguishable, and instead we find a group of structures which are leaf-like in being green and flattened, and stem-like in producing from their tissue flowers and roots. These are conveniently termed *fronds*, the name applied to the leafy portions of ferns, which bear seed on their backs. In *Lemna minor* the small, flat, roundish fronds are borne in little rosettes, the result of each frond giving off a young one at one side of its base. In *L. trisulca*, on the other hand, the young fronds are given off at right angles, one on each side of the centre of the old frond. They are at first sessile and triangular, but ultimately lanceolate and stalked. Instead of soon separating and commencing an independent existence, as in *L. minor*, they often remain attached, so that a flat network of fronds is the result, as shown in the figure. In both species each frond bears a short root, furnished with a prominent cellular cap at the extremity; the roots hang down in the water, and the plants drift about. The flowers are

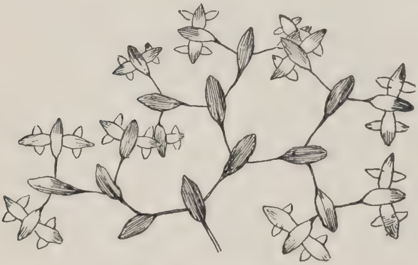
FIG. 17.—IVY-LEAVED DUCKWEED, *Lemna trisulca*. Half natural size.

exceedingly minute, and are seldom produced. They spring from clefts on the edge of the fronds. Each consists of two stamens and a pistil enclosed in a minute bract; or, according to some authorities, flowers in threes, in a minute spathe, the male flowers consisting of a single stamen, the female of a single ovary, with a short style and stigma. The remaining plants of the Order *Lemnaceæ* are **Lemna gibba**, which resembles *L. minor*, but is hemispherical beneath owing to the development of light spongy tissue, in consequence of which the plant is very buoyant and the flat green surface of the frond is raised above the level of the water; **L. polyrrhiza**, which is the largest British species, having roundish fronds half-an-inch in length, green above, purple below; finally, there is **Wolffia Michelii**, a tiny species found on pools near London. It is the smallest known flowering plant. The fronds are like grains of sand, without roots, flat on the upper side, on which the flowers are borne. The new fronds soon detach themselves from the old ones; Sir J. D. Hooker gives their size as one-twentieth of an inch long by one-fortieth broad. All the Duckweeds propagate themselves so rapidly by division that flowers appear unnecessary, and are very seldom found.

One more aquatic plant—a thorough hydrophyte—we must examine before we go. This is the **Common Bladderwort**, **Utricularia vulgaris**, of which we fish up a long dripping stem from among the Bullrushes. As in *Myriophyllum*, the leaves are divided into hair-like segments, but they are twice or three times pinnate, and are produced alternately on the stem. The striking feature of the plant is the numerous little bladders which are borne on the leaves, and from which it derives both its Latin and English name. Roots there are none, and the long stems float freely in the water. It is still too early for flower; but, indeed, we might not find flower later on, for the plant does not blossom abundantly. But it is well worth watching the pools for Bladderwort flowers, for they form a remarkably pretty sight. From the centre of a tuft of floating stems a rather tall leafless stem rises into the air, bearing alternate beautiful yellow flowers, in shape like a flattened Snapdragon, being two-lipped and closed; the lower lip is very large and broad, deflexed at right angles all round, not longer than the upper lip. The corolla is extended backwards into a conical spur. Three other species are found in the British Isles. **U. neglecta** is rare. It resembles *U. vulgaris*, but is much more slender in all its parts; the upper lip is longer than the lower, which has a broad flat margin; the spur is pointed and directed upwards. **U. intermedia** is more easily identified by the fact that the bladders and leaves are borne on different branches (see Fig. 34, p. 125). This is a much smaller plant. The leafy shoots are not cylindrical, but flattened, on account of the leaves being all more or less in one plane; it is a rare plant, and seldom blossoms; the flower is closely similar to that of *U. neglecta*. **U. minor** is a much commoner species, and is the smallest British Bladderwort. The stems are exceedingly slender, the leaves short, bearing minute bladders; the flowers are small, on little wiry stems a few inches high, and differ from those of the other species in being nearly destitute of a spur. The interest of the **Bladderworts** centres chiefly in the curious structures from which they derive their name. These vesicles have been shown to be modified leaflets, and certainly they are strangely modified. Each consists of a membranous oblong little sack, with a small aperture at the upper end, which is closed by a valve or door that opens inwards and shuts as with a spring against a thickened collar or door-frame which surrounds the opening. Around the aperture are a number of stout forked bristles. If any small animal, such as a water-flea, pushes against the little door, it opens easily, but closes immediately the intruder has passed in, imprisoning it securely. The bladders are, indeed, simple but deadly effective traps for the capture of minute crustaceans, &c. Kerner von Marilaun states[1] that twenty-four such animalcules have been counted in a single vesicle. The animals thus imprisoned die, their bodies decompose, and the products of decomposition are absorbed. That this animal food is actually beneficial to the plant is shown by Büsgen's observation that those plants from which all water-fleas were artificially excluded did not flourish so well as those in normal conditions.[2] Thus here we have the curious case of a plant which derives its food directly neither from the atmosphere nor from the soil, but from the water in which it floats and the animals which it entraps.

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[1] "Natural History of Plants," i., p. 122.

[2] Geddes, "Chapters in Modern Botany," p. 32.

In the autumn the Bladderworts produce dense buds at the ends of their shoots. As the stems and leaves die and decay, these buds sink to the bottom, like those of the Frog-bit, and remain there, secure from frost and storm, till the spring, when they rise and produce the plants of the succeeding year. In Fig. 34, drawn from a specimen of *U. intermedia* collected in Connemara in April, the winter bud or *hybernaculum* is clearly shown.

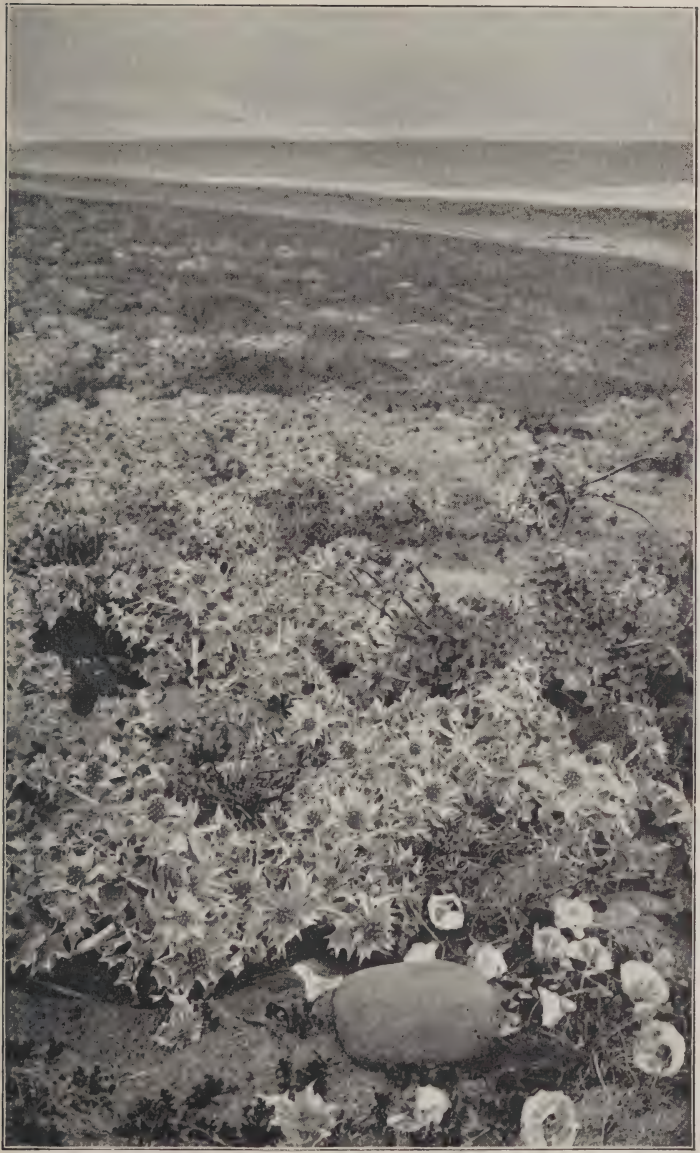
All the British species are hydrophytes, but the same does not apply to foreign Bladderworts, some of which live on damp ground, or among rocks, or on the bark of trees. Yet, although the conditions under which these exist are so different, they produce bladders very similar to those borne by the aquatic species. The Bladderworts belong to the Order *Lentibularieæ*, the remaining British members of which, the Butterworts, *Pinguicula*, will appear in a later scene (p. 121).

SCENE IV

AMONG THE SHINGLE

(The Murrough of Wicklow, *July* 1896.)
[Plate II.]

Northward and southward for miles stretches the broad shingle-beach, fading into the blue dimness of a hazy July day. In front, the calm waters of the Irish Sea fill the landscape, from the distant cloudland to the near foreground, where lazy gulls rock with folded wings, and the waves break crisp and short on the steep shingle, and rattle the pebbles up and down. Behind the beach lie green marshy pastures, with wooded slopes and meadows beyond, and behind all the bare brown mountains. We stand on the grey ridge of gravel above the mark of spring-tides, amid an abundant vegetation of low, stout plants. What strikes us first, perhaps, is the abundance of blue and grey tones in this shingle-flora, which harmonise with the grey tints of the gravel on which it grows. The Sea-Holly, which forms a large portion of the vegetation, has smooth grey leaves and stems, and grey heads set with blue flowers. The upper leaves and bracts have an edging of the brightest blue, and are frequently suffused with the same colour. The Sea-Spurge, which also abounds, is glaucous and grey-green. The Horned Poppy has foliage so thickly covered with soft white hairs that a silvery effect is the result, which contrasts beautifully with its large bright yellow flowers. Even the prevailing grasses, species of *Agropyron* and *Festuca*, contribute to this uniformity of colour. Note the bushiness and toughness of the vegetation here, and the prevalence of creeping underground stems and very long roots—essential attributes of species which inhabit such a home, where in winter storms the shifting shingle is swept by wave and spray, and in summer-time the worse danger of drought must be faced, and all the year round the wind whistles and sings across the shelterless ridge.



SEA-HOLLY, SEA-BINDWEED, AND HORNED POPPY.

MURROUGH OF WICKLOW, *July* 1896.

PLATE II.]

The leaves of these plants are specially protected against over-evaporation by means of a thick impermeable skin or a dense coat of hairs, and by a reduction in the number of stomata. A closer examination will reveal further adaptations of the plants to their peculiar environment. Food is scarce here among the shingle. Note how the shoots of the little Sea-Purslane, *Arenaria peploides*, have thick fleshy leaves, in which food and water can be stored up for the arid season of summer. The long succulent underground stems of the Sea-Holly serve the same purpose. Note the Sea-Spurge, the tall shoots of which do half their growth in one season, and then rest for a winter before flowering.

The most prominent plant, as will be seen by the photograph of our scene, is the **Sea-Holly**. The whole foreground is made up of its spiny, leathery, bluish foliage and prickly flower-heads. A curious and beautiful plant this, not at first recognisable as a member of the Order **Umbelliferæ**, the usually distinct characters of which have been already described (p. 37). Instead of the soft much-divided foliage that characterises most of the plants of this Order, we find here hard, stiff, roundish leaves, fringed with strong spines, and in lieu of the disk-shaped compound umbel, with its stiff and formal branching and plane of white or pale blossoms, we have a more or less globular spiny head of bright blue flowerlets. Nevertheless, in essential characters the plant falls in with the *Umbelliferæ*. The fruit has the structure so characteristic of the Order; the spiny heads may be considered as simple umbels, the flower-stems of which are very short. The Sea-Holly,

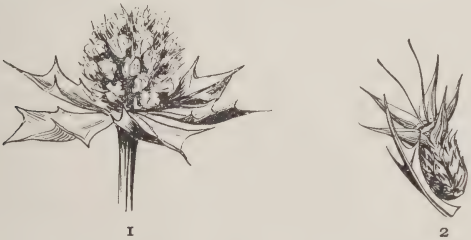


Fig. 18.—Sea-Holly, *Eryngium maritimum*.

1, Umbel with involucre (half natural size); 2, Single fruit and bract (× 2).

indeed, belongs to a small group of the *Umbelliferæ*, characterised by bearing simple umbels, and in all these plants the leaves also are more simple than is usually the case. Other examples of this group are the little **Pennywort, Hydrocotyle vulgaris,** so common in marshy ground, which has flat, circular leaves, with the stem almost in the centre (*peltate*), and tiny clusters of almost sessile pinkish flowers, much shorter than the leaves; also the **Wood-Sanicle, Sanicula europæa,** whose pretty palmate leaves are so familiar in woods; in this plant the inflorescence consists of a number of small simple umbels with almost sessile flowers, arranged on stalks of irregular length at the top of a common stem. But to return to our Sea-Holly. Note the very long underground stems, which are sometimes candied and used as a sweetmeat. It is vain work trying to get the plant up "by the root." The leaves and stem are exceedingly smooth and glaucous. The upper leaves clasp the stem. Below each head is a ring formed of five equal-sized leaves, generally much tinged with blue. Every flower of the head has below it a three-pointed bract. The petals and stamens turn inwards in a curious manner. The fruit is bristly, crowned with the five-toothed calyx. There are numerous foreign species of *Eryngium;* many of them are hardy, and are favourite plants of cultivation; a strong family likeness pervades all, and some of them are more beautifully suffused with blue than our own Sea-Holly. One other species only is found in Britain, the **Field Eryngo, Eryngium campestre**, a rare plant, of uncertain occurrence in some of its stations. It is immediately known from *E. maritimum* by its twice or thrice pinnatifid leaves.

Another plant which delights in this bare, exposed gravel-bank is the **Sea-Spurge, Euphorbia Paralias;** its stems, thickly clothed with short, glaucous, oblong leaves, and some of them crowned with the yellowish umbellate inflorescence, rise in clusters among the Sea-Holly. This is an interesting plant, and belongs to a peculiar and interesting genus. All the British representatives, over a dozen in number, are herbaceous. A few, like the well-known **Sun Spurge, E. Helioscopia,** and that common weed the **Petty Spurge, E. Peplus,** are annuals, but most have a perennial root-stock. Their upright stems, clothed with narrow or broad simple leaves, are generally unbranched except at the top, where they split to form an umbel, sometimes geometrically regular, as in the Sun Spurge, sometimes irregular. It is in the flowers that the chief peculiarity lies. On a cursory examination, we see what appears to be a more or less bell-shaped corolla, with a number of stamens inserted at its base or on its inner face, and a prominent curved pistil terminating in a large knob. But if this knob be examined, it is found to consist of a three-celled ovary bearing three styles. What we took to be a single flower is, as a matter of fact, a group of flowers. Our "corolla" is a kind of involucre. Each stamen represents a male flower, and in the centre, supported on a stalk, rises the single female flower. In the Sea-Spurge the involucre is yellow, its lobes spreading, and notched round the margin. Of the various other British Spurges, the only one with which it is likely to be confounded is the **Portland Spurge, E. portlandica,** which frequently grows in similar situations. The latter is a smaller plant, with more spreading, less glaucous leaves, which are distinctly apiculate; the four lobes of the involucre are half-moon shaped, and the seeds are pitted and netted, not smooth, as in the Sea-Spurge. These plants are members of the *Euphorbiaceæ*, an Order remarkable for the variety of form, and for the powerful medicinal properties which many of the species possess. The Spurges and others secrete a milky juice, highly acrid, and often violently poisonous. Nevertheless, some valuable food-materials, among which the West Indian cassava and the familiar tapioca may be mentioned, are prepared from plants of this Order. The only British representatives besides the Spurges are the Box, and the two species of Mercury, which make their appearance in a subsequent chapter (p. 235).

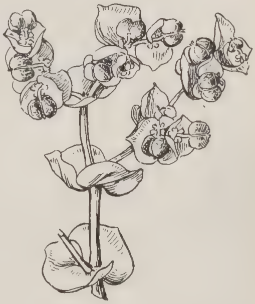


FIG. 19.—INFLORESCENCE OF SEA-SPURGE, *Euphorbia Paralias*. Half natural size.

Close to where we stand another grey-leaved bushy plant makes itself conspicuous by its large poppy-like yellow flowers. Our casual diagnosis is correct; this is a member of the **Papaveraceæ**, well known as the **Horned Poppy, Glaucium flavum**. We note the calyx of two sepals, which drop off as the flower opens; the four equal petals, the many stamens—all characteristics of the Poppies. But the fruit is very different in appearance. Instead of

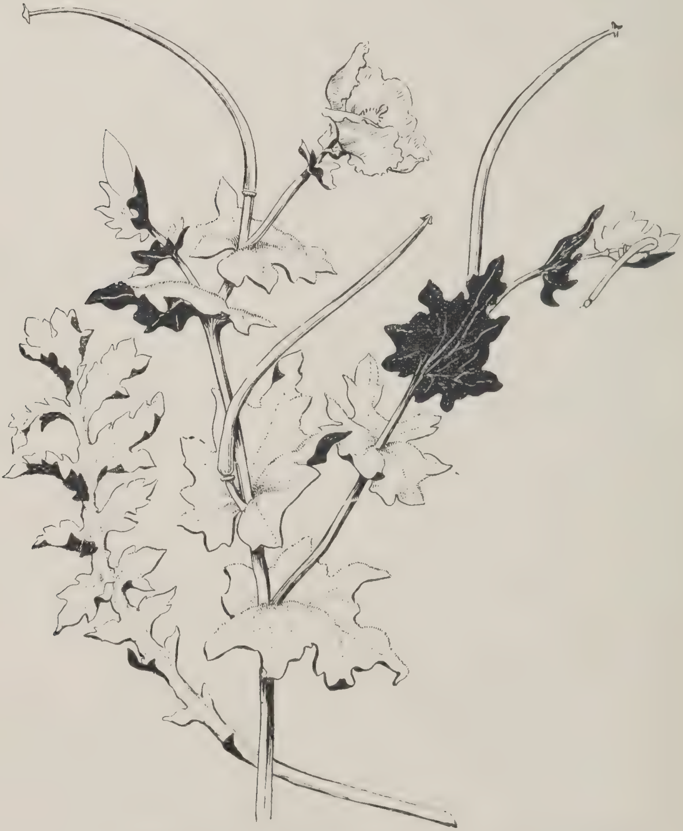


FIG. 20.—HORNED POPPY, *Glaucium flavum*. One-fourth natural size.

a capsule opening by pores below a disk which bears radiating stigmas, we have in *Glaucium* a great curved pod, crowned with two stigma-lobes, and splitting from top to base. In the flower the ovary is quite short, surrounded by a dense cluster of orange stamens, but it lengthens rapidly, so that when mature it often measures a foot. These great sickle-shaped pods are indeed quite as striking a feature of the plant as its showy flowers and beautiful silvery foliage. A still less Poppy-like member of the *Papaveraceæ* is the well-known Greater Celandine, *Chelidonium majus*, with its delicate pinnatifid leaves and umbels of small yellow blossoms. Here the fruit takes the form of a linear pod about an inch long, beaded throughout its length, and splitting from the base upwards. The copious bright orange juice alone will distinguish this species from almost any other British plant.

Another characteristic plant of the sea-shore, and one of the loveliest of many lovely plants that select this home, is clearly seen in the foreground of our photograph. It is the **Sea-Bindweed, Volvulus Soldanella**, at once known from the other species of Bindweed by its short stems, which do not climb, and its small, fleshy, kidney-shaped leaves. The stems are frequently buried, and only the leaves and the large bell-shaped blossoms, pale pink and striped with rose-colour, rise out of the arid sand. The other two British species. the **Great Bindweed, Volvulus sepium** (see Plate III.), and the **Field Bindweed, Convolvulus arvensis**, cannot well be confused, the former being generally twice as large in all its parts as the latter; but a safe criterion will be found in the pair of bracts which are situated on the flower-stem. In *V. sepium* these are large and close below the calyx; in *C. arvensis* they are very small, and situated about half-way up the flower-stem.

The only other British representatives of the Order to which the Bindweeds belong (*Convolvulaceæ*) are a genus of plants very different from them in appearance, and among the most formidable of vegetable pests—namely, the **Dodders, Cuscuta**. These are true parasites, drawing all their nourishment from the various plants on which they live. Having no occasion to seek their food and drink from the air and the soil, like honest, self-supporting plants, they have dispensed with leaves and roots as unnecessary encumbrances, and have perfected a system of strangling their neighbours by means of their close-twining thread-like stems, and of drawing the life out of them with little disk-like suckers with which they are plentifully provided. With the nutriment thus stolen they develop an abundance of flowers in little globular clusters, which in due course produce a plentiful supply of seed for next year's growth. The life-history of the Dodders is exceedingly curious. The small seed, which has been lying on or in the earth during the winter, does not germinate till spring is well advanced, deliberately waiting, one might say, till the plants which it will presently attack have produced a fair amount of vegetation. When the embryo, which is coiled like a spring inside the seed, commences growth, one extremity pushes its way into the soil and anchors itself there. The other rises up, carrying the seed and the little store of reserve food which it contains, and lengthens till, the food-supply being exhausted, it casts the useless husk away, and appears as a bare upright thread, which begins turning its point round and round, feeling for a victim. If it touches a juicy growing stem of the right species, its fortune is assured. It straightway coils itself round it, develops suckers which penetrate the host-plant, and having thus obtained food, it rapidly grows and spreads, attaching itself to every similar shoot it can find. In this way a comparatively small number of seedlings, successfully started, will increase amazingly, spreading from plant to plant, destroying everything as they go, and sweeping onward till a whole crop is as completely devastated as a forest by a forest-fire. But should the seedling fail in meeting with a plant of the right species—should it meet with dead shoots only, or with unsuitable plants, then its position is indeed critical. It is quite unable to derive any food or moisture from the soil in which its extremity is fastened, and eventually it falls to the ground. But even then its resources are not exhausted, for should a shoot of a suitable host-plant in the course of growth touch the prostrate stem even several weeks afterwards, it will at once seize it, and its danger is over. Should no such event occur, the seedling must die.

Of the five or six species of Dodder which have been found in Britain, several are plants of recent introduction. One, the **Flax Dodder, Cuscuta Epilinum**, appears to find a suitable host-plant in the Flax alone, but most of the others can live on a variety of species. **C. Epithymum,** for instance, the commonest native species, flourishes equally on Thyme, Gorse, or Ling, though these plants belong to widely-different Natural Orders, and possess very different properties.

But to return to our gravel-beach. In the more overgrown spots, where the Bird's-foot Trefoil and the Yellow Bedstraw form a close and verdant carpet, grow two plants with Dandelion-like flowers, which we recognise as belonging to the **Ligulifloræ**, that division of the great Order **Compositæ** in which all the individual flowers of the head have a strap-shaped or *ligulate* corolla, and to which the Chicory, Hawk-weeds, and the familiar Dandelion belong. The two plants which grow at our feet are, in general characters, very like the last-named, especially as regards their yellow flower-heads; they belong to a group of Dandelion-like plants which the beginner will find it hard enough to distinguish one from another. Perhaps to some the confusion is increased by the similarity of the English names of certain of them—Hawk-bit, Hawk's-beard, Hawk-weed, Cat's-ear, Ox-tongue—all *animal* names, it may be noticed, in most cases bequeathed on account of somewhat fanciful resemblances. But if we collect these confusing plants and dry them, and now compare our specimens one with another, the difficulties will be lessened. The critical characters by which botanists distinguish the various genera to which they belong are principally minute differences of flower or seed; and while these must not be lost sight of, if we wish to steer safely through the maze, nevertheless a general comparison will soon reveal characters by which we may name the half-dozen common species which are most inclined to puzzle us. For instance, we can group our plants according to their general habit of growth. We place together those which have tall, *leafy* stems. This will bring some dozen or more plants together, if our collection is at all complete. They belong to the genera *Crepis* (Hawk's-beard), *Picris* (Ox-tongue), *Lapsana* (Nipple-wort), *Lactuca* (Lettuce), *Sonchus* (Sow-Thistle), and the accipitrine or leafy-stemmed section of the Hawk-weeds (*Hieracium*). All these we may put aside for the present, for the common plants which puzzle us are not among them; we shall return to them presently (p. 157). Let us now classify the remainder according as their flower-stems are branched or simple. Two or three fall into the first group, and they may be immediately disposed of. This plant, with a rosette of rough, hairy, pinnatifid leaves with broad rounded tips, smooth forked flower-stems, erect buds, and a very long thick root, is the **Long-rooted Cat's-ear, Hypochæris radicata.** The next is the **Autumnal Hawk-bit, Leontodon autumnalis**, which we may at once know from the Cat's-ear by its short thick root-stock, from which proceed a number of roots not thicker than twine, and by the numerous scales upon its branched flower-stems. This is a variable plant, sometimes very hairy, sometimes glabrous; and the leaves vary, being sometimes much toothed and cut, sometimes almost entire. The only other common plant which might find a place in this group would be some member of that perplexing genus, **Hieracium** or **Hawk-weed,** probably **H. murorum.** From the plants already mentioned this may be differentiated by its ovate undivided leaves, on stalks as long as the blade. One other, however, may puzzle us. This is the **Smooth Hawk's-beard, Crepis virens,** a plant that masquerades under various disguises, now growing several feet in height, with an upright, much-branched stem, with numerous pinnatifid sagittate leaves, and an abundance of small yellow flower-heads; now stunted on the sea-shore, with a number of small radical leaves, and many slender slightly-branched flower-stems only a couple of inches high; but its *glabrous* leaves, *small* heads of flower (about half-inch diameter), and tapering tap-root will distinguish it.

We have still left those plants with unbranched flower-stems. Of these, the **Dandelion, Taraxacum officinale,** with its smooth hollow stems, glabrous leaves, and long tap-root, is familiar to us; the

> "Dear common plant, that grows beside the way,
> Fringing the dusty road with harmless gold,"

of Lowell. Next come two plants with abundant hairy root-leaves, more or less toothed, and hairy upright stems bearing solitary heads, which *droop when in bud.* These are the **Hairy Hawk-bit, Leontodon hirtus,** and the **Rough Hawk-bit, L. hispidus.** They are tolerably like each other, but a little practice in the field will soon teach us to distinguish them at a glance. Compared with *L. hirtus*, *L. hispidus* is a larger plant, with fewer and larger flower-heads on longer stalks. Lastly, we have a pretty little plant with entire leaves very white beneath, lemon-coloured flowers beautifully tipped with red below, and long leafy stoles or creeping shoots. This is the **Mouse-ear Hawkweed, Hieracium Pilosella.**

Thus we have roughly noted the more conspicuous characters by which the commoner Dandelion-like plants, a stumbling-block to many a young botanist, may be known from each other; and while the method is imperfect, and should never replace their determination by means of the recognised generic and specific characters that are to be found in flower and fruit, nevertheless such a grouping may assist the beginner, and if followed out is sure to furnish an instructive lesson in the careful comparison of plants which he is too inclined to pass by as hopelessly confusing.

Dotted here and there over the sward grows the **Yellow-wort, Blackstonia** (= *Chlora*) **perfoliata.** We know it by its slender erect stem, its opposite pairs of glaucous leaves, which join at the base to form a leafy ring round the stem, and its clusters of pretty deep yellow flowers. The leaves are the most striking feature of this plant. The root-leaves, which form a small rosette, are narrowed below and rounded at the apex. Those of the stem are in opposite pairs, short, broad, and pointed, and connected by the whole width of the base with one another; as the text-books would say, they are *broadly connate.* The Yellow-wort is the only British member of the genus; it belongs to the **Gentianeæ,** and is a near relation of the beautiful Gentians, whose exquisite deep blue flowers are so familiar to us. The British species of Gentians are few in number and easily recognised. The largest of them is **Gentiana Pneumonanthe,** which has bell-shaped flowers an inch or more in length, dark blue in colour, with a greenish stripe running down the centre of each of the five lobes of the corolla. In the British Isles it is confined to England, where it is found in a limited number of counties

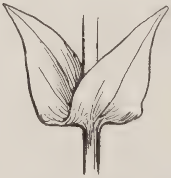


FIG. 21.—PERFOLIATE LEAVES OF YELLOW-WORT, *Blackstonia perfoliata.* Half natural size.

growing on moist heaths. **G. verna** is a rare species. It is a small tufted perennial with short flower-stems, each bearing a single blossom of intensest blue. It grows sparingly in the North of England, and much more abundantly on the limestone in parts of the West of Ireland, where in May certain areas are brightly tinted with the glorious blue of its starry blossoms. **G. nivalis** is a small annual with deep blue flowers, found at high elevations on a few Scotch mountains. The only British Gentians which may be reckoned common are **G. Amarella** and **G. campestris.** They are both small, branched, erect, annual plants, with numerous flowers, which are purplish in the former, lilac in the latter. In general appearance these two are similar, but they may be distinguished by the calyx, which has *five almost equal narrow segments* in *G. Amarella*, and in *G. campestris four segments, two very broad and two very narrow.* The corolla also furnishes a simple distinguishing character, being *five-cleft* in *G. Amarella* and *four-cleft* in *G. campestris.* Fig. 22 shows these differences clearly. Closely allied to the Gentians is the **Centaury, Erythræa**, the bright pink flowers of which are so familiar. Belonging to the same Order, but very different in appearance, are the Bog-Bean (*Menyanthes trifoliata*) and the Water Villarsia, *Limnanthemum peltatum*, which were mentioned in our last scene (p. 51). The *Gentianeæ* are a large Order, widely spread over the globe; the few that are found in our Isles are all charming plants, and justly rank as high favourites with the lover of wild-flowers.

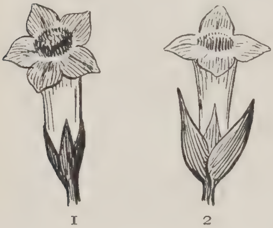


FIG. 22.—FLOWER OF (1) *Gentiana Amarella*; (2) *G. campestris.* Natural size.

Amid the tumbled fringe of coarse vegetation behind the beach, where the Bent-grass, *Ammophila arundinacea*, rears its white panicles and waves its tall, slender, pointed leaves, several large herbaceous plants stand up conspicuously. The first of these is the **Hound's-tongue, Cynoglossum officinale**, a member of the **Boragineæ**, the Order to which the Borage, Comfrey, and Forget-me-not also belong. Note its lanceolate downy leaves, leafy stem, and small dark crimson flowers. The fruit is pretty, and will alone distinguish the plant; it consists of four large very bristly nuts seated on the broadened base of the style. The bristles are short, strong, and barbed so effectually that, after an autumn stroll on the sand-hills, one's clothes are frequently thickly covered with the detached nuts, which have to be picked off with considerable labour. On one occasion, after an hour's ramble along the coast of County Louth, I removed over five hundred of them from one stocking! And the sheep which were grazing there had thousands entangled in their fleeces.

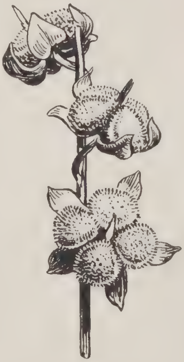


Fig. 23.—Fruit of Hound's-tongue, *Cynoglossum officinale.* Natural size.

This ingenious method of dispersal, by which wandering animals are the unconscious means of carrying seeds far from the parent plant, is one which is found in many of our common wild-flowers. In the Burdock, *Arctium*, it is the involucre that bears the very tough hooks which cause the fruit-head to adhere so persistently to any rough object which it touches. The fruits themselves, it is interesting to note, are, like those of so many *Compositæ*, furnished with a feathery pappus, so that this plant has, as regards the dispersal of its seeds, two strings to its bow. In the Goose-grass, *Galium Aparine*, and the Enchanter's Nightshade, *Circæa lutetiana*, it is the fruit itself that bears the hooked bristles; in the Agrimony, *Agrimonia Eupatoria*, they are borne on the calyx-tube. The Bur-Marigold, *Bidens*, furnishes an example of a Composite plant with hooked fruit. In this genus the fruit has several ribs, on which are strong hooks, and these ribs are prolonged into straight spines (representing the calyx), which are also armed with hooks. Sir John Lubbock has pointed out[1] that of all British plants which bear hooked fruits, none are so lowly, or none so tall, that their fruits would not have a chance of becoming entangled in the fur of an animal; all of them are herbs, a foot or two in height. In other words, hooked fruits are borne only by plants which can make a full use of the opportunity afforded by passing animals for dispersing their seeds. He also points out that the only British plants that possess winged fruits, like those of the Ash, which we have already examined, or the Sycamore, are *trees*, the fruits of which, on account of the superior elevation at which they are borne, have an opportunity of being widely dispersed by the wind. It may be pointed out that the feathered fruits of Composites and other plants, being exceedingly light, can fly far without the assistance of a considerable elevation at starting, as we at once see when the breeze rustles across a field of Ragwort or Thistles.

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[1] "Flowers, Fruits, and Leaves," p. 79 (1886).

Close by stands another member of the *Boragineæ*—the **Viper's Bugloss, Echium vulgare**. This is a striking and handsome plant. Like the Hound's-tongue, it is usually biennial, sending downwards a long tapering root, from which in the first year springs a rosette of lanceolate leaves, and in the second year a tall, branched, leafy flower-stem. All the leaves are rough with coarse hairs, each hair seated on a little tubercle—a feature characteristic of plants of this Order. The flowers of *Echium* are abundant and beautiful. The main stem of the plant is long and stout, and bears a number of short curved branches, on the upper side of which the flowers are arranged in a dense row. In bud they are bright red; as they open they change to purple, and when fully expanded are of a brilliant blue. This change of colour may be noticed in quite a number of species of the *Boragineæ*, such as the Narrow-leaved Lung-wort, *Pulmonaria angustifolia*, Smooth Gromwell or Oyster-plant, *Pneumaria* (=*Mertensia*) *maritima*, and several species of Forget-me-not or *Myosotis*. As in the Hound's-tongue, the root is long and tapering, suited for ensuring a steady supply of moisture in the dry situations which it favours. This is one of the handsomest inhabitants of the sand-hills: and he who discovers a group of tall plants of *Echium*, as they stand erect in the July sunshine, a blaze of dazzling blue, will bless the fate that led him to their sequestered home amid the yellow dunes.

On a little mound, where at some time the surface has been disturbed by digging, another tall plant has established itself; it has quite taken possession of this vantage-point, and its stiff, unbranched stems rise conspicuously among the shorter herbage. This is the **Dyer's Rocket, Reseda Luteola.** Its flowers at once remind us of those of that garden favourite, the Mignonette, which, indeed, is a member of the same genus, inhabiting Egypt. In our islands this Order, **Resedaceæ,** is represented by only two species, **Reseda Luteola,** and **R. lutea**; but another, **R. alba,** a garden plant, native in Southern Europe, sometimes establishes itself in dry, sandy ground. These three species have a strong family likeness, but may be easily separated. If we examine the tall plants of *R. luteola* which sway in the sea-breeze in front of us, we note its upright almost unbranched stem, adorned with many smooth, narrow, blunt, undivided leaves; the stem terminates in a long, narrow raceme of small greenish-yellow flowers. The calyx is divided into four segments; the petals are very uneven in size and shape, and their number is not constant, being sometimes three, sometimes four, and more rarely five. Like the other plants of the genus, it has a large bundle of conspicuous stamens. The short capsule is split into three lobes, exposing the seeds. From this plant, *R. lutea* and *R. alba* may be easily distinguished by their leaves, which are pinnatifid, with wavy segments. *R. lutea* is a branched, bushy plant, with larger and handsomer yellow flowers on longer stalks. The calyx is divided into six segments; the petals are six, and very unequal; the capsule is larger than in *R. Luteola*, oblong, and opening at the apex. *R. alba* is more like *R. Luteola* in its narrow, almost solitary, racemes, but the leaves are much divided and of a grey hue. The flowers are different from either of the other species, having five comparatively large and almost equal trifid petals, which are white. None of the British species possess the delicious fragrance that makes the Mignonette one of the highest favourites of all our garden flowers.

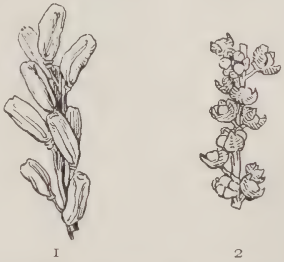


FIG. 24.—PORTION OF FRUITING-SPIKE OF (1) DYER'S ROCKET, *Reseda Luteola*, and (2) WILD MIGNONETTE, *R. lutea*. Half natural size.

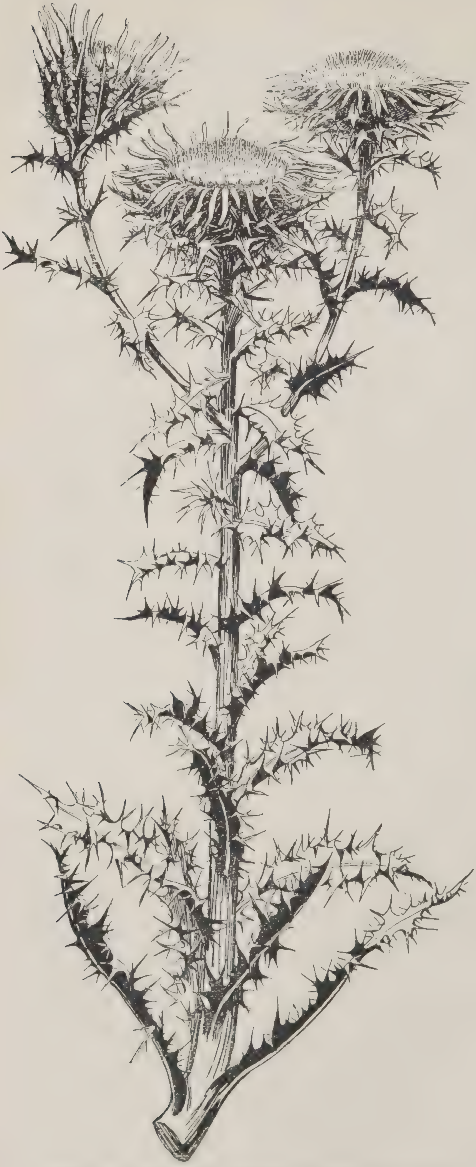


FIG. 25.—CARLINE THISTLE, *Carlina vulgaris*. Half natural size.

We have incautiously grasped with careless hand the mossy top of a sandy bank as we step over it, and a sharp pain brings our thoughts and eyes back to our immediate surroundings, and recalls the fact that Thistles also flourish here. What a quaint plant this is, with a short, erect stem, so densely armed with prickly grey-green leaves that we procure a specimen only by careful digging with our fingers to reach the stout, unarmed root. The flower-heads, very large for the size of the plant, are also densely spiny, and the dull yellow flowers themselves are the only portion of the plant that we can touch with impunity. This is the **Carline Thistle, Carlina vulgaris,** the only British representative of the genus; and it belongs to that group of the *Compositæ* (**Cynarocephaleæ**), in which the flowers are all tubular, such as the Burdocks, Knap-weeds, and Thistles. The present plant cannot be confounded with any of the other Thistles; it is easily known by its large heads, of which the outer phyllaries are leafy and spiny, and the inner row flat, smooth, and yellow, like the ray-flowers of the Daisy group. These flower-like leaves, as well as the flowers themselves, and indeed the whole plant, are very dry and hard, and remarkably persistent, so that in mid-winter, or even in the early summer of the next year, the dead, bleached plants may be seen still standing erect and uninjured by storm, or rain, or frost, except that the leaf-material decomposes by degrees, leaving only "skeletons" consisting of the veins and hardened margins. The petal-like inner phyllaries are very sensitive to moisture. In damp weather they close like a cover over the flowers, and this sensitiveness in certain species lasts long after death, so that the heads of the Continental *C. acaulis* are used by the peasants in some districts as hygrometers.

Carlina naturally leads us to the **Thistles** in general, which must rank among the most picturesque of all our native plants. Their tall, bold growth, their beautifully-cut armed leaves, and handsome spiny heads, combine to produce highly artistic forms—forms which are duly appreciated by the landscape painter and by the designer. The agriculturist, however, has very different sentiments towards them. They are numbered among his worst foes. Their thousands of feathery fruits find their way to every spot, and grow and multiply exceedingly; and some, such as the too common *Cnicus arvensis*, have succulent root-stocks, which creep so rapidly and extensively, and are so tenacious of life, that to eradicate them is almost a hopeless task. Most of the Thistles belong to the genera **Carduus** and **Cnicus,** closely-allied groups distinguished by the hairs of the pappus having very short secondary hairs in the former, so as to appear only rough, while in *Cnicus* the secondary hairs are longer, so as to give the pappus a feathery appearance. The determination of the species in these genera does not present any difficulties to the beginner. **Carduus nutans,** the **Musk Thistle,** is easily known by its large solitary drooping heads and large lanceolate phyllaries. **C. crispus,** the **Welted Thistle,** has numerous small roundish heads of dark crimson flowers; the involucre is composed of very slender phyllaries, among which webby threads extend. **C. pycnocephalus,** the **Slender-flowered Thistle,** is similar in general growth, but its foliage is grey instead of dark green, its flowers pink instead of deep crimson, its heads smaller, with much narrower involucres, not webbed, and composed of broader erect phyllaries. Of *Cnicus* the species most commonly met with are **C. lanceolatus,** the **Spear Thistle,** one of the handsomest of the group, and almost too well known to require definition here, but critically distinguished by its *decurrent* leaves *hairy above,* and its *egg-shaped* involucres; **C. eriophorus,** a rarer plant, with very large heads, *globose* woolly involucres, and leaves *hairy above,* but *not decurrent;* **C. arvensis,** one of the commonest weeds in pasture-lands, with almost sessile lanceolate leaves, and numerous small heads of pink flowers: the egg-shaped involucre is composed of broad adpressed phyllaries, which are nearly glabrous and almost without spines; the root-stock, as before remarked, creeps extensively. **C. palustris,** the **Marsh Thistle,** is as common as the preceding, but frequents damper ground: the stem has spinous wings, and the numerous small heads of dark crimson flowers are in clusters at the ends of the branches. In general appearance it resembles *Carduus crispus,* but even without examination of the pappus it can be known from the latter by its broad adpressed phyllaries, which are not spiny. **C. pratensis** and **C. heterophyllus** are somewhat like each other, both having leaves whitish beneath and destitute of actual prickles, and large, mostly solitary, purple heads; but *C. heterophyllus* is twice as large a plant as the other, and the under side of its variable-shaped leaves is much whiter and more downy. **C. acaulis** has rather large solitary heads, which are usually almost without a stem; its glabrous leaves and roots with filiform fibres help to distinguish it. Two other plants must be mentioned before leaving the Thistles; each of them belongs to a separate genus. The **Cotton Thistle, Onopordon Acanthium,** is a large and handsome plant, with tall branched stems conspicuously winged, leaves woolly on both sides, involucres globose with large spreading spinous phyllaries, and handsome heads of purple flowers: it is the true Scotch Thistle. The other is the

Milk Thistle, Mariana lactea, also a beautiful and striking plant. The leaves are very large, shining green with white veins; the heads conspicuously armed with long and formidable spreading spines, which are the extremities of the large close-pressed phyllaries. The Milk Thistle is not a true native of Great Britain, though often found in wild-looking situations.

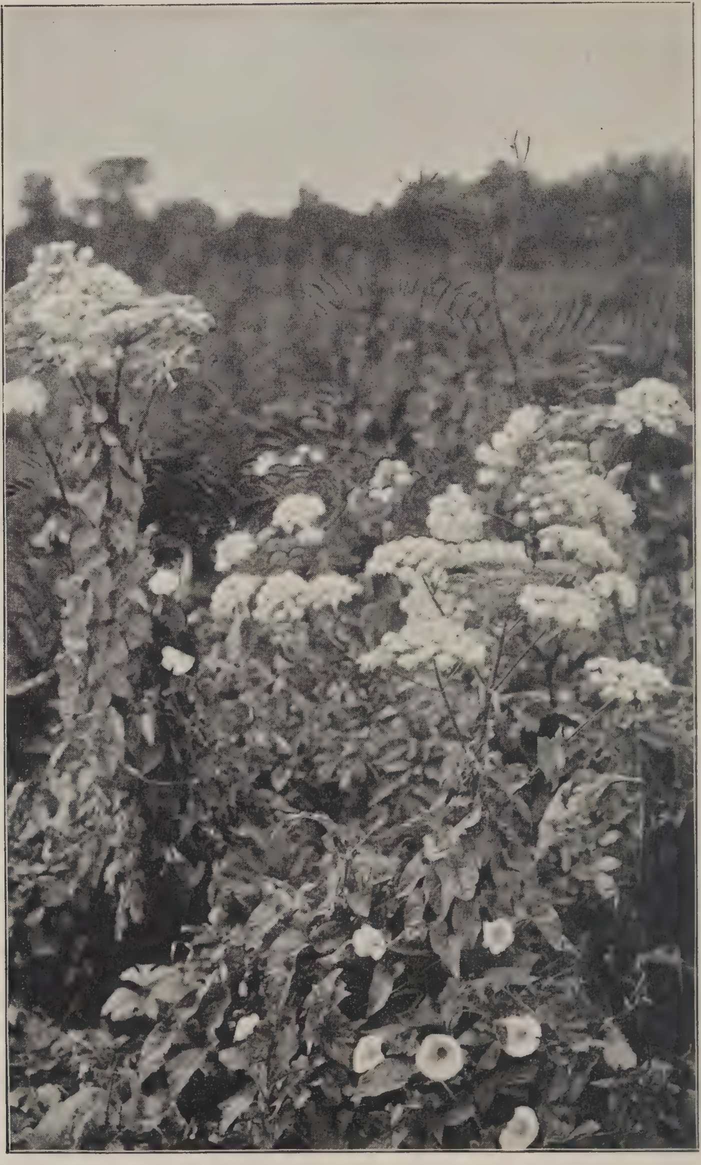
Why, it may be asked, have the Thistles such a formidable development of spines upon their leaves, stems, and flower-heads? There can be no doubt that the function of the spines is protective, and directed against the attacks of grazing animals. How effective this armour is in this connection we may observe any day. Here and there over the pasture cropped close by the cattle, the handsome forms of the Spear Thistle and Marsh Thistle rear their juicy stems and leaves, untouched and uninjured, and open their flowers to the sun, and perfect and disperse their feathered fruits without fear of molestation. In the Thistles the protective spines are borne on almost every part of the plant—on the stems, on the involucres (note the formidable spines on the involucres of *Mariana* and *Onopordon*), and particularly on the wavy margins of the leaves. On some other plants we find spines on the leaves alone—the Holly, *Ilex*, is an example; and in the Holly it is interesting to note that the spines are found chiefly on those leaves which are in actual danger of attack. In low-growing or young bushes all the leaves are profusely spined, but in bushes which have sprung up beyond the reach of herbivorous animals the margin of the leaf is without any defensive armour. In many plants certain portions of the *stem* assume the form of spines, and thus protect the unarmed leaves. The Hawthorn, *Cratægus Oxyacantha*, will serve as an example. Here lateral shoots assume the form of strong spines, developed in the axils of foliage-leaves. The spines protect these leaves from molestation, and in the next year they protect the leaves and flowers that develop from the axillary bud, which is situated at the base of each spine. The Barberry, *Berberis vulgaris*, exhibits another arrangement. In this shrub two kinds of leaves are produced—small flat shiny leaves, and others which are transformed into a series of radiating needle-like spines. The ordinary leaves, and also the flowers, are produced in the axils of the spiny leaves, and are thus admirably protected. The Furze or Gorse, *Ulex*, furnishes a still more complete example of protection from the attacks of animals, for in this plant *all* the leaves are converted into the sharp green spines we know so well, and all the branches end in spines likewise. These spine-leaves are very different from the trifoliate leaves of most of its allies, such as the Broom, Clover, Medicks, and Melilots; and it is interesting to note that a seedling of the Gorse commences life with small trifoliate leaves, which become modified into spines after the first few pairs (see Fig. 59, p. 199); thus the plant betrays the origin of its spine-leaves, which have evidently been gradually developed from leaves originally trifoliate.

Several other plants which deserve mention occupy this verdant zone that lies behind the belt of Sea-Holly and Sea-Spurge. The first one we stoop to examine is the **Lady's-fingers, Anthyllis Vulneraria.** By the shape of its flowers we at once recognise it as a member of the well-marked Order **Leguminosæ.** Its appearance is, however, different from that of the familiar Clovers and Vetches. From the root-stock proceed a number of straight branches bearing dense heads of yellow flowers, usually in pairs. The leaves are pretty, of a glaucous hue, and pinnate, having several pairs of leaflets and a large terminal one. The pairs of flower-heads are usually so close together as to appear one; they are surrounded by palmate bracts, which form a kind of involucre. The calyx is peculiar, being large and inflated, pale yellow or white in colour, and extremely downy, so that it is more conspicuous than the small yellow corolla. Another species of the same Order that is abundant here is the **Rest-harrow, Ononis repens.** It derives its English name from the toughness of its long subterranean shoots. This is a pretty plant, with dark green foliage and bright rose-red pea-like flowers. The stems are procumbent, the leaves sticky, with a powerful odour. A closely-allied species is **O. spinosa,** differing in being usually erect and shrubby, with a short root-stock and no creeping shoots; the pod is distinctly *longer* than the calyx, whereas in *O. repens* it is distinctly *shorter. O. spinosa* usually bears spines at the extremities of the branches, while *O. repens* is usually without spines.

We wander again towards the water's edge, and discover that some plants habitually grow still nearer the sea than the Sea-Holly, for go as far as we will, we find them still on the verge of high-water mark and nowhere else. The most conspicuous of these is the **Purple Sea-Rocket, Cakile maritima**, which we recognise as belonging to the **Cruciferæ.** The stem is much branched, the leaves smooth, fleshy, and pinnatifid, the flowers lilac, the pods short and thick, and jointed in a curious manner, so that each consists of a short lower portion, containing a single seed, and a longer upper segment also containing one seed. When the fruit ripens the upper joint falls off. *Cakile* is an annual, growing up in early summer into a little green bush studded with pretty lilac blossoms, and fading in the autumn, when its seeds get buried in the drifting sand and lie there till spring again advances. Another bushy plant of different appearance is here—the **Saltwort, Salsola Kali**, so called on account of its alkaline properties. Its curious leaves are cylindrical and succulent, terminating in a sharp spine. The flowers are minute, in the axils of the leaves. The fruit is worth examining. It is enveloped in the persistent calyx, which is star-shaped on account of having five spreading wings. The seed is roundish, and the embryo which it contains is beautifully coiled in a slightly-conical spiral, so that it resembles the shell of some small mollusk. A third plant grows here also, its long prostrate shoots half buried in the sand. This, like *Salsola*, belongs to the Order **Chenopodiaceæ.** It is **Atriplex Babingtonii**, a member of a difficult genus. The species of *Atriplex* vary greatly, and excepting *A. portulacoides* (Sea-Purslane), and the rare *A. pedunculata*, which are well-marked plants, it may be considered a matter of opinion into how many species they should be divided. The flowers are of two kinds—small male or perfect flowers, with a five-parted perianth and a few stamens, and female flowers, with a perianth of two comparatively large triangular or diamond-shaped, flattish, adpressed lobes, more or less warty, enclosing a two-styled ovary. In fruit, the green fleshy perianths are tolerably conspicuous. Our plant has long spreading stems and mealy, triangular, leathery leaves with rounded angles, and numerous warty perianths. The Atriplices are an uninteresting race, abounding on cultivated or waste ground, especially near the sea, and they are plants that the beginner will probably prefer to leave alone.

It will be seen that we can arrange the plants of our gravel-beach in zones. Lowest of all come *Salsola*, *Atriplex Babingtonii*, and *Cakile*, leathery and succulent plants growing in patches on the bare shifting shingle, and not to be found except on the sea-shore. Behind them is the belt of *Eryngium* and *Euphorbia Paralias*, of *Volvulus Soldanella*, and *Glaucium*, which do not venture forward to the sea-edge like the former group, yet do not retreat to the carpeted sands behind. These also are essentially seaside plants, with tough or fleshy leaves. Beyond the *Eryngium* zone we get a more varied vegetation, with *Echium*, *Cynoglossum*, *Ononis*, *Anthyllis*, *Reseda*, *Carlina*, plants which are not confined to the shore-line, but frequent it apparently more on account of its supplying a light sandy soil, such as they love, than by reason of any predilection towards the neighbourhood of the sea.

But evening has overtaken us. Already *Carlina* has closed its spiny heads, and the large delicate bells of the Sea-Bindweed are open no longer. In the stillness of sunset even the long leaves of the Bent-grass stand motionless. The humming of the bees has ceased, and in their place pale moths flutter noiselessly over the herbage: and now a Nightjar breaks the silence with his weird crooning, and in the gathering twilight we can fancy he is singing the flowers to sleep.



GREAT BINDWEED TWINING UP WILD ANGELICA.

Bective Abbey, Co. Meath, *June* 1896.

Plate III.]

SCENE V

A FRAGRANT HEDGEROW

(DUNDONALD, CO. DOWN, *June* 1896.)
[PLATE III.]

> "Hedgerows engarlanded with many a wreath,
> Where the wild roses hang their blushing treasures,
> And to the evening gale the woodbine breathes."
> —CHARLOTTE SMITH.

IN this pleasant country lane the air is filled with the singing of birds and the sweet scent of wild-flowers. On the one side, a pebbly streamlet ripples along, trespassing sometimes on the grass-grown roadway. On the other, the lane is overshadowed by a great hedge, that has not known the billhook or shears for many a long year, and its green arching branches shelter the mossy bank below, and hang down under the weight of their foliage all wet with recent showers, so that they brush the backs of the lazy cattle that lounge along on their homeward way. In the thick hedge Sparrows are squabbling and chirping, and a Blackbird is rustling the dead leaves in the hollow behind the bank. One or two Crab-Apples spread above the top of the hedge, and a few tall Ivy-clad trees rise far into the air above. The low bank under the hedge is daintily clothed with Feather-moss, and Wild Violets, and Germander Speedwell, and sprays of creeping Ivy. Other plants are rooted on the top of the bank, but rise straight up and climb through the branches above. The Tufted Vetch is one of these, and the Goose-grass another. Other stronger climbers rise as high as the top of the hedge, and hang in gay festoons and leafy sprays—yellow Honeysuckle, and pink Wild Roses, and Brambles, and Great Bindweed.

To these **climbing plants** we must pay particular attention, for they afford many interesting adaptations for their life of scrambling and pulling themselves upward, and some of them exhibit a sensitiveness and a power of movement that are truly wonderful. Darwin—it is remarkable how naturally we fall back on Darwin when the careful observation of biological phenomena is in question—divided climbing plants into four groups: "First, those which twine spirally round a support, and are not aided by any other movement. Secondly, those endowed with irritable organs, which, when they touch any object, clasp it; such organs consisting of modified leaves, branches, or flower peduncles. . . . Plants of the third class ascend merely by the aid of hooks, and those of the fourth by rootlets." The last two classes are the simplest forms, and the plants belonging to them do not display in connection with their climbing the remarkable power of movement possessed by those which climb by means of twining stems or tendrils. Of the **root-climbers** we have an ever-familiar example in the Ivy, *Hedera Helix*. Here it is in our hedge, growing up the thick stems of the trees that rise into the sunlight; clinging close to the bark, adhering so firmly that often the stem will break before the rootlets will relax their hold, or sometimes the rootlets will drag off patches of bark rather than loosen their grasp of the supporting tree. The **hook-climbers** are provided with reflexed hooks on their stems or leaves, by which they support themselves in the tangled vegetation which they frequent. Like most climbing plants, they have weak and slender stems, which could not stand alone; they rely on their neighbours for support and for shelter. Here in the hedgerow the hook-climbers are in full force. Look at the festoons of sweet Dogroses and the long arching shoots of the Brambles—both are amply furnished with strong curved prickles. We realise how firmly a Bramble is anchored to the surrounding thicket when we endeavour to drag a long spray out of the hedge. Not only do the strong recurved prickles of the stem resist the downward drag, but the lateral branches, which spread widely, and the broad spreading leaves, the petioles and midribs of which are also furnished with hooks, combine to hold the spray in position. Best known of our native hook-climbers is the Goose-grass, *Galium Aparine*. It is a brittle and slender plant, but the innumerable reflexed bristles with which its stems and leaf-edges are beset render it an efficient climber. Another interesting case is that of *Veronica scutellata*, the

Marsh Speedwell. Alone among British Speedwells it lives among tangled vegetation, in the coarse grassy herbage of marshes; and alone it has adopted a scrambling habit, and has linear leaves with backward-pointing teeth, by which it may cling to the neighbouring vegetation.

The **twiners** climb by quite a different device; their slender supple stems coil spirally round any convenient upright support, and thus rise to elevations that are often considerable. But although they are not dependent on hooks or such like anchors for maintaining their position, it is interesting to note that many twiners have leaves with strong spreading or reflexed petioles, which no doubt assist materially to anchor them. The power of movement incessantly manifested by the growing tips of twining plants is a remarkable feature of their history. Darwin's experiments and observations on these phenomena, though, as he hastens to acknowledge, anticipated in some measure by those of Palm, Hugo von Mohl, and Dutrochet, form the classic memoir on the subject, and the most accessible for English readers. They will be found in the volume entitled "The Movements and Habits of Climbing Plants." The movements exhibited by the **Hop,** a typical twiner, he thus summarises: "When the shoot of a Hop (*Humulus lupulus*) rises from the ground, the two or three first-formed joints or internodes are straight and remain stationary; but the next formed, whilst very young, may be seen to bend to one side and to travel slowly round towards all points of the compass, moving, like the hands of a watch, with the sun. The movement very soon acquires its full ordinary velocity. From seven observations made during August on shoots proceeding from a plant which had been cut down, and on another plant during April, the average rate during hot weather and during the day is two hours eight minutes for each revolution; and none of the revolutions varied much from this rate. The revolving movement continues as long as the plant continues to grow; but each separate internode, as it becomes old, ceases to move." Darwin found that in the twining plants which he examined, generally the three highest internodes, but in some cases only the two uppermost, shared in the revolving movement. Sometimes the movement is one of striking magnitude—as, for instance, in the case of a foreign climber, *Ceropegia Gardnerii.* "I allowed the top to grow out almost horizontally to the length of 31 inches; this now consisted of three long internodes, terminated by two short ones. The whole revolved in a course opposed to the sun (the reverse of that of the Hop) at rates between 5h. 15m. and 6h. 45m. for each revolution. The extreme tip thus made a circle of above 5 feet (or 62 inches) in diameter and 16 feet in circumference, travelling at the rate of 32 or 33 inches per hour. The weather being hot, the plant was allowed to stand on my study table; and it was an interesting spectacle to watch the long shoot sweeping this grand circle, night and day, in search of some object round which to twine." The rotating movement consists of a bending to all sides, one after the other. Thus, if the east side of a shoot be painted black, the black streak will be found in succession on the convex side of the shoot, then on one edge, then on the concave side, then on the other edge; but it will face the east all the time. The shoots of climbing plants usually exhibit also a certain amount of twisting, and the twisting is usually in the same direction as the revolving movement of the tip; but it is not an effect of this movement, as Darwin and others have shown. The stems of some twiners never become twisted, and in some species the twisting of the stem is in the opposite direction to the revolution of the shoot. Mohl found that when a stem twines round a smooth cylindrical support it does not become twisted, and Darwin narrates his confirmation of this fact by experiment; but when the support was rough much twisting of the axis at once took place. This twisting undoubtedly increases the rigidity of the stem, and the stem is thus better able to pass over inequalities in its ascent.

The revolving movement or **nutation** of twiners is the immediate cause of their spiral twining. The shoot in its course strikes against a support. The portion above the point thus arrested continues to revolve, higher and higher points of the shoot are brought into contact with the support, and a spiral coil is the result. The course described by the tip of a nutating shoot varies in different species. It is often a circle; in many other cases an ellipse, sometimes a very narrow ellipse; and in others again a semicircle, the shoot becoming straight and upright during half its course. The direction of revolution is in some species with the hands of a watch, in others in the contrary direction; while in a few rare cases, such as certain members of the exotic Order *Loasaceæ*, the revolution is sometimes in one direction, sometimes in the other; and individual plants when climbing apparently change their minds, and suddenly commence to nutate and twine spirally in a direction the reverse of that which they had previously followed. The period required to complete one revolution also varies much. Darwin gives a time-table of the movements of such plants as he studied, which shows a period of from 2 to 10½ hours for shoots moving at their full speed. Shoots move more slowly when they are very young, or when their free nutation is hindered by contact with a support. Darwin quotes an interesting experiment which shows that when the support round which a shoot has coiled is removed, the shoot may again commence to nutate, and thus seek a fresh support. The experiment was made with the shoot of *Ceropegia* already alluded to. "The lower and older internodes, which continued to revolve, were incapable, on repeated trials, of twining round a thin stick; showing that, although the power of movement was retained, this was not sufficient to enable the plant to twine. I then moved the stick to a greater distance, so that it was struck by a point 2½ inches from the extremity of the penultimate internode; and it was then neatly encircled by this part of the penultimate and by the ultimate internode. After leaving the spirally-wound shoot for eleven hours, I quietly withdrew the stick, and in the course of the day the curled portion straightened itself and recommenced revolving; but the lower and not curled portion of the penultimate internode did not move, a sort of hinge separating the moving and the motionless part of the same internode. After a few days, however, I found that this lower part had likewise recovered its revolving power."

Our hedge is not wanting in examples of twining plants. Witness the supple brown coils of the Woodbine, *Lonicera Periclymenum*, one of our few shrubby twiners, and the tall leafy stems of the Great Bindweed, *Volvulus sepium*, coiling in a close spiral up yonder *Angelica* (Plate III.), and mixing its white trumpets with the large umbels of its supporter. The Black Bryony, *Tamus communis*, so common in English hedgerows (though not extending to Scotland or Ireland), is another bold and far-reaching twiner.

The leaf-climbers and tendril-bearers are closely allied, both climbing by means of sensitive organs. The genera *Clematis* and *Tropæolum* furnish well-known examples of leaf-climbers. Their slender stems nutate, often irregularly both as regards direction and the form of curve made by the tip. In some the stems have the power of twining, but the revolving movement has for its principal object the bringing of the leaf-stems into contact with surrounding objects. When these are of a suitable nature, the petiole twines round them, by curving towards the point of contact, carrying the leaf with it. In the pinnate leaves of some species of *Clematis*, the secondary petioles are also sensitive and ready to clasp. When a petiole has coiled round a support, it becomes much thicker, and ultimately exceedingly tough, rigid, and durable, so that it remains as an anchor long after the deciduous leaflets have faded and passed away. A few foreign species clasp not by their petioles, but by the tips of their leaves, which are elongated and sensitive on the under side. One unpretentious and familiar weed of our cornfields, the Common Fumitory, *Fumaria officinalis*, is, as Darwin has pointed out, a true leaf-climber, and one of erratic movements. Both the young internodes and the leaves themselves are continually in motion, of a very irregular nature, and the primary and secondary petioles have the power of clasping thin stems, &c., which they touch in their peregrinations. A close ally of the Common Fumitory, the Climbing Fumitory, *Neckeria claviculata* (see p. 206), furnishes a connecting link between the leaf-climbers and the tendril-climbers. Its compound leaves bear both tendrils—filamentary organs, used exclusively for clasping—and leaflets, which are likewise sensitive, and the one organ merges into the other. Darwin found that the tendril-like upper portion of the delicate compound leaves is very sensitive, the pressure of a loop of thread weighing only one-sixteenth of a grain causing it to become greatly curved in less than four hours. The most familiar of our native tendril-climbers are the Vetches. Two of them grow here in our hedge—the Bush Vetch, *Vicia sepium*, and the Tufted Vetch, *V. cracca*. It will be remembered that we examined the former in our first ramble. Its weak stem is held up by the thread-like tendrils at the tips of its pinnate leaves, which are tightly wound round every twig of sufficient thinness. The Tufted Vetch is a bolder climber, and puts forth its pretty purple clusters of flowers full six feet above the ground, having climbed to this eminence with stems no thicker than twine. In the Vetches, and most of the Vetchlings, it is the terminal and upper pairs of leaflets that are modified into tendrils. One interesting exception occurs in the case of *Lathyrus Aphaca*, the Yellow Vetchling; in this plant the function of assimilation is performed by the enlarged and leaf-like stipules, while the rest of the leaf is converted into a delicate unbranched tendril (see Fig. 28, p. 105). Indeed, in most of these plants, the leaf-area lost by transformation into filiform tendrils is made good by the increased size of the stipules, or by the leafy wings of the stem.

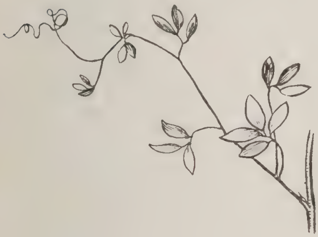


FIG. 26.—LEAF OF CLIMBING FUMITORY, *Neckeria claviculata*. Natural size.

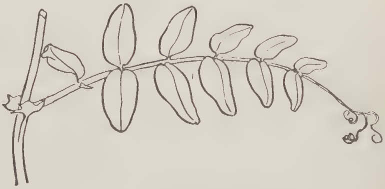


FIG. 27.—LEAF OF BUSH VETCH, *Vicia sepium*. Half natural size.

A tendril-bearer of another kind is found in the White Bryony, *Bryonia dioica*, so common in the hedgerows of Southern England. The leaves are large and five-lobed, and do not bear tendrils; but from the stem, beside the leaf-stalks, spring long undivided tendrils, which have been regarded by some authorities as modified leaves, by others as flower-peduncles. These revolve continually, and on meeting with a support, grasp it with a close coil of many revolutions. The whole tendril then contracts spirally, drawing the shoot nearer to the support, and acting efficiently as a spring against sudden shocks.

In the well-known Virginian Creeper of our gardens, *Ampelopsis*, the tendrils, which are modified flower-peduncles, are branched and rather short. They do not exhibit any revolving motion, but turn away from the light. When they encounter any body, they lay themselves down on it like the fingers of a hand; the tips swell, and adhere closely to the support, and become firmly glued to it by means of an adhesive fluid secreted by the cells on that face of the disk-like knob which is in contact with the support. The disks do not need a rough surface in order to adhere, but can fasten themselves to painted wood or iron, or even to glass. The tendril finally contracts into a spiral, drawing the plant close to the sheltering support.

In all cases the advantage which plants gain by climbing is the same—they ascend into the light and air, where their leaves and flowers can carry on their functions to greater advantage. This superiority of position is achieved with a marvellously small expenditure of material. The climbers obtain support and protection from the trees or shrubs to which they cling; their stems have not either to support the weight of the plant or to withstand wind-pressure; and while most plants have to build up stout solid or hollow columns for these purposes, the stems of the climbers need be no thicker than is necessary for the conveyance upward of the water supply, and they take the form, among most of our native examples, of slender perennial or annual wands, or coils, or ribbons. The twining plants climb with a greater expenditure of material than do the tendril-bearers, owing to their spiral growth. In every way, indeed, the tendril-bearers are highest in the scale of climbing plants. Their slender wiry stems rise straight up, moving round and round incessantly, in order to bring the tendrils into contact with a support. The tendrils themselves also sweep the air with the same object. One of them touches the twig of a shrub; promptly it bends towards it, and takes several turns round it. When it has securely attached itself, it draws the stem upwards towards the newly-found support by means of a spiral contraction. Its object accomplished, all movement ceases, and the tendril becomes very strong and elastic, forming a durable anchor for the stem, which grows onward and upward, hand over hand, to burst into bloom far above the lowly herbs among which it began its life. "It has often been vaguely asserted," says Darwin in the concluding paragraph of his essay, "that plants are distinguished from animals by not having the power of movement. It should rather be said that plants acquire and display this power only when it is of some advantage to them; this being of comparatively rare occurrence, as they are affixed to the ground, and food is brought to them by the air and rain. We see how high in the scale a plant may rise when we look at one of the more perfect tendril-bearers."

The movements of climbing plants naturally lead us to consider the **movements of plants** in general. For the revolving motion or **circumnutation**, which is so conspicuous in the climbers is not confined to plants which have acquired this habit, although in climbing plants the movement is particularly noticeable, and the advantage to the plant conspicuous. On the contrary, Darwin states that "all the parts or organs in every plant whilst they continue to grow are continually circumnutating. This movement commences even before the young seedling has broken through the ground." The radicle or first root, directly it has burst the seed-coat, commences to nutate. Its tip is exceedingly sensitive. It is its sensitiveness to gravitation that causes it to at once bend downwards. As it grows, it is continually pushing against the earth on all sides in its endeavour to revolve. If it encounters a hard obstacle, such as a pebble, the tip bends away from it, following the line of least resistance, creeps round its edge, and again proceeds on its downward course. The plumule or hypocotyl similarly circumnutates as soon as it breaks through the seed-coat, and is thus assisted in finding the easiest way to the air above. When it has forced its way into the daylight, the hypocotyl, which was bent back upon itself (in all dicotyledonous plants), straightens out, the cotyledons expand, and circumnutate vigorously. "Our seedling now throws up a stem bearing leaves, and often branches, all of which, whilst young, are continually circumnutating. If we look, for instance, at a great Acacia tree, we may feel assured that every one of the innumerable growing shoots is constantly describing small ellipses, as is each petiole, sub-petiole, and leaflet. The latter, as well as ordinary leaves, generally move up and down in nearly the same vertical plane, so that they describe very narrow ellipses. The flower peduncles are likewise continually circumnutating. If we could look beneath the ground, and our eyes had the power of a microscope, we should see the tip of each rootlet endeavouring to sweep small ellipses or circles, as far as the pressure of the surrounding earth permitted. All this astonishing amount of movement has been going on year after year since the time when, as a seedling, the tree first emerged from the ground." Thus Darwin refers to the universal nature of the phenomenon of circumnutation in his work on "The Power of Movement in Plants" (1880). Other movements of plants—the deflection of leaf-stalks as the blade expands, the upward or downward bending of many flower-peduncles before or after flowering, the nyctitropic or sleep-movements referred to in a previous chapter (p. 26), the heliotropic movement, or bending towards the light, that is so conspicuously displayed by most plants, and the upward bending of stems and downward bending of roots—all these are held by Darwin to be movements of circumnutation, modified by internal or external causes. The extreme sensitiveness of seedlings to light is remarkable. Darwin narrates how seedlings kept in a dark place, and laterally illuminated by a small wax taper for only two or three minutes at intervals of about three-quarters of an hour, all became bowed to the point where the taper had been held; and the cotyledons of the grass *Phalaris* became curved towards a distant lamp, which emitted so little light that a pencil held vertically close to the plants did not cast any shadow which the eye could perceive on a white card.

Certain movements, however, cannot be referred to the action of circumnutation, and these movements are the most remarkable in the vegetable kingdom. Such are the sudden drooping of the leaves of the "sensitive plant," *Mimosa pudica*, which, on being touched, almost instantaneously assume the attitude of sleep, and the rapid closing of the tentacles of the Sundew, *Drosera*, on receiving the stimulus caused by a tiny insect or fragment of meat.

The mechanical explanation of the widespread phenomenon of circumnutation does not appear to have been as yet made clear. Sachs and other eminent physiologists sought to account for it on the assumption that the different sides of a shoot grow at unequal rates, this depending on altered water-tension in the growing cells. Other writers suggest that the movement is induced by the contraction and expansion — owing to changes of water-tension—of rows of cells in the shoot. "Why every part of a plant whilst it is growing," remarks Darwin, "should have its cells rendered more turgescent and its cell-walls more extensile, first on one side and then on another, thus inducing circumnutation, is not known. It would appear as if the changes in the cells required periods of rest."

From these physiological marvels we must turn to our fragrant sunny hedgerow, and pay some attention to its inhabitants. The Woodbine, which trails and twines among the branches, is one of the half-dozen British members of the **Caprifoliaceæ,** a rather small Order of plants allied to the *Rubiaceæ*, and consisting almost entirely of shrubs or small trees. The **Woodbine, Lonicera Periclymenum,** the only British species of its genus, differs from its allies in its twining habit and its capitate irregular flowers. The perennial stem often climbs to considerable heights. The blossoms are specially adapted for insect visitors. They are irregular, with a tubular corolla split into an upper four-lobed lip and a lower entire one. Honey is secreted in the tube, and the flowers are deliciously fragrant, and conspicuous owing to their being grouped together; so that in every way they lay themselves out for attracting insects. The berries are juicy and bright scarlet, and therefore attractive to birds. Two other species of Honeysuckle are occasionally met with as garden escapes—**L. Caprifolium,** which closely resembles the last, but may be known by its upper leaves being connate, or joined together round the stem; and **L. Xylosteum,** a shrub which does not twine, and has two-flowered peduncles. The nearest ally of the Woodbine is a little trailing plant, **Linnæa borealis,** found in fir-woods in Scotland, and as far south as Yorkshire. Its wiry stems creep extensively, and bear opposite pairs of small round leaves and short ascending peduncles, on each of which hangs a pair of delicate bell-shaped pink flowers. This graceful plant is of peculiar interest to all botanists, as being the "little northern plant, long overlooked, depressed, abject, flowering early," which Linnæus himself selected to transmit his name to posterity, and which Gronovius, at his request, named *Linnæa.* **Viburnum,** or Guelder-Rose, is represented in Britain by two species, and one of them is here in our hedge, its handsome foliage and flat corymbs of white flowers rendering it a conspicuous object. This is **V. Opulus,** the **Common Guelder-Rose,** a shrub with smooth lobed and cut leaves, and the outer flowers of each panicle very large and quite barren—"flags," as Lubbock calls them, used for purposes of advertisement, while the smaller inner ones perform the business of seed-production. Such devices for the attraction of insects we shall meet with in several other plants (p. 164). The other species is **V. Lantana,** the **Mealy Guelder-Rose,** or Wayfaring-tree, common in English hedgerows, but unknown in Scotland and Ireland. Its leaves are egg-shaped with a finely serrate margin. The young shoots, petioles, and under side of the leaves are densely woolly; and the flowers of its flat panicles are all of the same size and perfect. To this Order belongs the **Elder, Sambucus,** also represented by two species. The **Common Elder, S. nigra,** is well known—a small tree with pinnate leaves and very large panicles of creamy flowers, which in autumn give place to rich bunches of luscious shining black berries. The **Dwarf Elder,** or Danewort, **S. Ebulus,** has a creeping root-stock, which sends up annual unbranched shoots terminating in panicles of pink flowers. From young shoots of *S. nigra* this species may be known by its serrate leaf-like stipules—organs which are absent in *S. nigra*—and by its powerful and characteristic stench when bruised. *S. Ebulus* is not reckoned an original native, but is thoroughly established and quite at home in almost all parts of our islands. The last member of *Caprifoliaceæ* is a plant of very different appearance, the **Moschatel, Adoxa Moschatellina,** a tiny herb, and one of our earliest spring flowers. Under hedges and in shady copses in April we find it. The creeping rhizome sends up one or two fragile ternate leaves and a slender stem, which bears a couple of small leaves and a small terminal head of green flowers. The head consists of four lateral flowers with a five-cleft corolla and a terminal four-cleft flower. This is a delicate and pretty plant, although insignificant. It ranges as far north as Aberdeen; in Ireland it grows only near Belfast.

The **Roses**, that vie with the Woodbine in lending beauty and perfume to our hedgerow, are a difficult group. Two species are here—**Rosa canina,** the **Dogrose,** with pale pink flowers, which are deliciously fragrant, and **R. tomentosa,** the **Downy-leaved Rose,** with downy foliage and deep red scentless blossoms. A number of other species and varieties grow in hedges and bushy places. The most easily recognised are **R. rubiginosa,** the **Sweet-Briar,** which may be known by its unequal prickles, deep rose-red flowers, and strongly-scented foliage; **R. arvensis,** the **Trailing Rose,** a glabrous plant with few large equal hooked prickles, sub-globose fruit, and large white odourless flowers; and **R. spinosissima,** the **Burnet Rose,** a low very prickly shrub, with small leaves and large cream-coloured deliciously-fragrant blossoms.

The **Vetches** are an attractive genus, independent of the special interest that attaches to them as highly organised tendril-climbers. Their arching pinnate leaves and clusters of bright flowers produce graceful and pleasing forms. Of Vetches proper—the genus **Vicia**—about a dozen species are natives of these countries. All have pinnate leaves, and almost all bear tendrils, and climb. Of the tendril-bearing species, **V. sepium,** the **Bush Vetch,** we examined in our opening chapter (p. 4). It may be known by its hairy egg-shaped blunt leaflets and shortly-stalked few-flowered clusters of dull purple blossoms. It is but a weak climber, and is common in hedgerows and bushy places. **V. cracca,** the **Tufted Vetch,** which brightens our hedge with its long racemes of blue flowers, is recognisable by this character alone. For the rest, the leaves consist of about ten pairs of narrow egg-shaped leaflets and a large branched tendril. It is a bold climber, and one of the handsomest of our Vetches. **V. angusti-**

folia, which is frequent in rough dry ground, has narrow-elliptic or linear leaflets and dark rose-red flowers, which are solitary or in pairs, on short stalks. **V. sativa,** the cultivated Vetch, is probably a variety of this, with broader leaves and larger flowers. **V. sylvatica** is a beautiful plant, frequenting rocky woods and glens. The leaflets are broadly elliptic, the tendrils much branched; the flowers are borne in racemes on long axillary stalks; they are large and white, veined with blue; the stipules are crescent-shaped and strongly toothed. **V. hirsuta,** the widely-distributed **Hairy Tare,** and **V. gemella, Smooth Tare,** which as a native is almost confined to England, are both slender plants with small pale blue flowers, borne a few together on a rather long peduncle, and leaves with narrow leaflets. *V. gemella* may be separated from *V. hirsuta* by its larger, *smooth* three- or four-seeded pods, and its leaves with three to six pairs of leaflets; *V. hirsuta* has very short two-seeded hairy pods, and leaves with six to eight pairs of leaflets. **V. gracilis** is a rare South of England plant, with long linear leaflets and flowers twice as large as those of *V. gemella,* of which it is regarded by some authorities as a variety. **V. lutea,** which grows on stony ground near the sea in England and Southern Scotland, is easily known by its rather large solitary sessile yellow flowers, one in the axil of each leaf. **V. bithynica** is a local English species, ranging as far north as Yorkshire. The leaves have two pairs of leaflets, which become narrower in the upper part of the stem, till at the top they are linear. The stipules are half sagittate with a toothed margin. The purple flowers grow singly on short stalks from the leaf-axils; the pods are hairy. Only two British Vetches are destitute of tendrils. **V. Orobus** is a fine bushy species, most resembling *V. sylvatica.* The midrib terminates in a stiff tapered point; the stipules are half sagittate and almost entire; the flowers white, tinged with purple. It grows in wooded and rocky places, and is rare, but widely spread. **V. lathyroides,** on the other hand, is a tiny branching annual, growing among the close herbage in sandy places near the sea, and similar situations. It might be passed over as a dwarfed form of *V. angustifolia,* but a second glance will reveal its absence of tendrils and its small purple flowers.

The leaves bear two or three pairs of obovate leaflets, and terminate in a short point.

The only other British Leguminous plants whose leaves are destitute of a terminal leaflet are the **Vetchlings, Lathyrus**; and most of them, like the Vetches, are tendril-bearers. *Lathyrus* differs from *Vicia* chiefly in the shape of the style, which is flattened and hairy on the upper margin only, while in the Vetches it is thread-like and hairy below or all round. We have had occasion to refer already (p. 97) to the curious **Yellow Vetchling, L. Aphaca,** in which the leaf-blades have become reduced to a tendril, and their legitimate work is performed by the large leaf-like stipules, which grow in opposite pairs, one on each side of each tendril-leaf. The flowers are yellow, solitary, on slender peduncles. This is a rare plant in the British Isles, confined to dry fields in the South of England. **L. Nissolia** has neither leaf-blades nor tendrils, but only broadened grass-like petioles which perform the functions of leaves. Its rose-red flowers are borne singly on long slender peduncles; the pods are long and narrow. It is found in bushy and grassy places from Cheshire southward. **L. pratensis** is the commonest of the genus, and is a familiar meadow plant. The leaves bear a single pair of leaflets and a branched tendril, and have a pair of large leafy stipules at the base. The bright yellow drooping flowers are borne in racemes on erect stalks, and are fragrant and pretty. The only other *Lathyrus* that can be designated common is **L. montanus** (= *macrorrhizus*), the **Tuberous Bitter Vetch.** This plant has a perennial tuberous root-stock, from which rise short annual shoots bearing leaves with two or three pairs of broad leaflets and a terminal point. There are no tendrils. The flowers are crimson when they open, turning to purple, and eventually to blue. The only other British *Lathyrus* without tendrils is **L. niger,** the **Black Bitter Vetch,** a rare Scotch sub-alpine species; it is distinguished

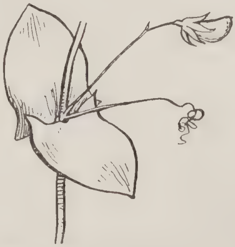


FIG. 28.—ONE NODE OF YELLOW VETCHLING, *Lathyrus Aphaca*, showing leaf-blade converted into a tendril, pair of leaf-like stipules, and axillary flower. Half natural size.

by its leaves with about five pairs of elliptic leaflets and a short terminal point, lanceolate entire stipules, and purple flowers with darker veins, changing to blue. The five remaining native Vetchlings, all of which are tendril-climbers, are as follows: **L. hirsutus** has leaves with one pair of narrow leaflets, small half-sagittate stipules, two-flowered peduncles, purple flowers with a crimson standard or upper petal, and hairy pods. It is a very rare English field-plant. **L. tuberosus** is confined to Essex. It is a pretty plant, with leaves bearing one pair of broad obovate leaflets, large half-sagittate stipules, and bright, rose-red flowers, five or six together. The root-stock is creeping, and bears tubers. **L. sylvestris** is a large and handsome plant with a broadly-winged stem which climbs five or six feet. The leaves have a single pair of large, narrow leaflets. The peduncles bear six to eight flowers, with a pale red standard and purplish wings. The pods are smooth. It grows among rocks and in thickets in England and Southern Scotland, but is often only a garden escape. **L. palustris** is, as its name implies, a plant of marshes. Among the tall Sedges and Grasses its slender winged stems rise several feet high. The leaves bear two or three pairs of narrow, acute leaflets: the blue flowers grow four or five together on long peduncles. **L. maritimus** is a native of pebbly beaches, almost confined to the east coasts of Scotland and England. Like so many plants that grow in such situations, it has smooth, glaucous foliage. The leaves bear about four pairs of leaflets; the stipules are large; the flowers purple and handsome.

The **Stitchworts** are a race of slender herbs. They are characteristic **Caryophyllaceæ,** possessing the entire leaves in opposite pairs, and white, regular, five-petalled flowers, that are so frequently met with in this Order. Several of them are confirmed scramblers, and although they are not provided with tendrils or hooks, they habitually live among tangled herbage, and hold themselves in place by means of their spreading leaves and branching stems. Two of them mix with the Vetches and Goose-grass in our hedgerow. These are **Stellaria Holostea,** the **Greater Stitchwort,** one of the dearest of spring flowers; and **S. graminea,** the **Lesser Stitchwort.** Both have narrow, grass-like leaves, but *S. Holostea* is much the handsomer on account of its large pure white flowers. As in all species of the genus, each petal is deeply cleft. The stamens are twice as numerous as the petals. The ovary bears three styles; it is one-celled and many-seeded. The fruit is a capsule opening by six valves at the top. *S. graminea* has smaller flowers than *S. Holostea*, the petals being only as long as the sepals, instead of twice as long, and the stems are much more diffusely branched. **S. palustris** is the only other species with narrow, sword-shaped leaves. It can generally be recognised by the glaucous hue of its foliage, seen among the Sedges and marsh-grasses with which it grows; its three-nerved sepals and smooth leaf-margins will at all times distinguish it from *S. Holostea;* while *S. graminea* is known by its more branched stem, more numerous smaller flowers, and ciliate leaf-margins.

S. aquatica, S. nemorum, and **S. media** have ovate acute leaves. *S. aquatica* differs in the structure of its flowers and fruit from the other species of *Stellaria*, having five styles instead of three, and a capsule that opens by five bifid valves, instead of by six entire valves. On this account the Swedish botanist Fries placed it in a separate genus, **Malachium.** It is a brittle, scrambling plant, with ovate-cordate sessile leaves (the lower shortly stalked), and axillary flowers with petals cleft almost to the base. This species grows on the sides of ditches, &c., in many English counties, but is not found in Scotland or Ireland. *Stellaria nemorum* closely resembles the last, but it has the normal structure of *Stellaria*, as noticed above—three styles and six capsule-valves, and the lower leaves have long petioles. It grows in woods and shady places in England and Scotland. *S. media* is the well-known and all-too-common Chickweed, one of the most abundant weeds on cultivated ground. The only plant that may be confounded with this is **Arenaria trinervia.** A glance at the flowers will decide which is which, for the Chickweed has deeply-cleft petals, while those of the Three-nerved Sandwort are entire. The Chickweed is also well distinguished by the hairy line which runs along its stem, shifting from side to side at each node. **S. umbrosa** is sometimes reckoned merely a variety of the last. It differs from it in its more erect habit, glabrous pedicels and sepals, and rougher fruit. It is rare, but ranges from Devonshire to Perth. **S. uliginosa,** the last of the Stitchworts, is universally common in wet places. It is the smallest of the genus. The leaves are glaucous and oblong, the flowers inconspicuous, the sepals longer than the petals, which are so deeply bipartite that they look like two petals on a common base.

The opposite side of our country lane, where the clear stream ripples over pebbles or creeps among the verdant water-grass, is made gay by the yellow wealth of Water Ragwort, *Senecio aquaticus*, that grows along the wet margin, while higher up on drier ground are a few plants of the Common Ragwort, *S. Jacobæa*. **Senecio** is the largest British genus of the **Corymbiferæ**—that section of the Order **Compositæ** in which the flower-heads usually possess a marginal row of ray-florets, which are female or neuter. Some familiar plants of this group are dealt with elsewhere—the Daisy, the Seaside Aster, the Golden Samphire. The British Senecios are ten in number. First comes a small group in which the heads are not rayed, or have an inconspicuous revolute ray. The **Common Groundsel, Senecio vulgaris,** is the best known of these; usually the ray is completely absent in this species. **S. sylvaticus, Mountain Groundsel,** is like the last, but is taller and less branched, with more numerous erect heads, which are shortly rayed, and the leaves are greyish with down; it is not uncommon in dry places. **S. viscosus, Stinking Groundsel,** is easily known by its sticky stems and leaves; it is a branched plant, with the appearance of the Common Groundsel; it differs from both the last in its fruit, which is glabrous, while in the others it is silky. The ray is short, and curls backwards as in *S. sylvaticus*. All these three have pinnatifid leaves. The next section of the genus is characterised by its heads with spreading rays, and pinnatifid leaves. Here belong the two species which grow beside our lane, the well-known **Common Ragwort, S. Jacobæa,** and the **Water Ragwort, S. aquaticus.** These two species, though much like each other, will be easily separated even by the beginner. *S. aquaticus* grows in wetter ground; it has less divided leaves, and larger flower-heads disposed in a much more lax corymb. The best distinguishing mark is to be found in the fruit. In *S. Jacobæa* the ray-fruits are glabrous and the disk-fruits hairy; in *S. aquaticus* all the fruits are glabrous. The remaining species of this section are **S. erucifolius** and **S. squalidus,** the latter an introduced plant run wild. *S. erucifolius* is a tall-growing plant with a short creeping perennial root-stock, short, simply pinnatifid leaves, and lax corymbose heads of lemon-yellow flowers. The fruit of both the ray and disk is hairy. This species grows on roadsides and banks throughout England; in Scotland it occurs only in the extreme south; in Ireland only on the east coast. *S. squalidus* is a South European species, thoroughly naturalised on old walls and rubbish-heaps about a few towns —Oxford, Bideford, Warwick, Cork. In Cork it is the commonest weed in the city; its bushy clusters of shining Groundsel-like leaves and rayed yellow flower-heads meet the eye in every spot where vegetation can obtain a hold. The remaining species of *Senecio* found in Britain are distinguished by possessing *entire* leaves. The only one of this section that is not extremely rare is **S. campestris,** the **Field Fleawort,** found on chalk-downs in England only. It produces a rosette of oblong cottony leaves, from the centre of which rises a short erect cottony stem bearing a few rayed yellow flower-heads. **S. palustris** and **S. paludosus** are two noble plants of the Fen district, now, alas! on the verge of extinction. The latter grows sometimes six feet in height, with lanceolate serrate leaves and large rayed flower-heads; *S. palustris* is a smaller, shaggy plant with less showy flowers and leaves more broadly lanceolate. Both have forsaken almost all their former habitats owing to the draining of the fens, and perhaps partially to the depredations of collectors. **S. saracenicus,** a plant of the European continent and Siberia, is sometimes found apparently wild in the British Isles, forming large patches on account of its creeping stems. This is a tall species, often four or five feet in height, the unbranched stems clothed with glabrous, lanceolate, serrate leaves and terminating in a large corymb of yellow flower-heads.

SCENE VI

A CONNEMARA BOG

(By Craigga-more Lake, near Roundstone, *July* 1896.)

For miles the bog extends, monotonous and desolate if we let the eye wander over the wide expanse, where the rich brown of the foreground melts into grey distance, and that into the greyer line of the Atlantic; yet full of colour, and beauty, and variety if we study the scene in detail. Here is a rough knoll, clothed in a purple mantle of Heather, and crowned with rocks patched with white and grey lichens; here the vivid green tells of a tiny streamlet, oozing over deep beds of *Sphagnum*, and bordered with yellow Butterworts and red-leaved Sundews; here, again, stretches a flat marsh, full of tall Sedges and Rushes, through which a deep, slow streamlet wanders with intricate windings, like a tangle of silver thread; and here flashes a clear lakelet filled with Water-Lilies—one of the many hundred similar lakelets that occupy every hollow westward to distant Clifden, and southward to the dark, serrated mass of Urrisbeg, which rises over the lovely bay of Roundstone. Close to the edge of one of these calm lakelets we choose an airy perch, near enough to the water to easily reach the numerous aquatic plants, yet sufficiently high to see across the bog to where, a few miles to the northward, rise the glorious mountains of Beanna Beola, the Twelve Bens[1] of Connemara. Wondrously beautiful these rugged hills, never the same for two hours together, but displaying continually new effects of cloud and colour. In the morning wrapped in a grey mantle of Atlantic mist, which breaks up into dazzling columns and pyramids of cloud, making the deep valleys below look black as night; and then the sunlight bursts through, at first in dappled patches on the hillsides, then in rich volume till the mountains seem to glow with yellow fire. At last the clouds are all gone, and the rugged quartzite ridges tower sharp and clear against the sky, and change slowly to deep purple as the sun goes down, and fleecy cloud-caps hang for a little over the highest crags, and then settle thick and grey over the fading landscape.

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[1] Commonly corrupted into Twelve *Pins*.

But it is with the more immediate surroundings that we are concerned. Our perch has been cunningly chosen to command a varied prospect in a very limited space, and a rich variety of plant-life. Below us, a few paces to the left, is a little rocky corner of the lake. It is fringed with Reeds and Twig-rush; the shallower parts gleam green with the verdant growth of Water-Lobelia and the rare Pipewort which cover the bottom, and send up a myriad of slender stems on which the flowers are raised above the water. Farther from the shore white Water-Lilies cover the surface. Just in front, the ground drops suddenly, and a little swampy patch occupies the lake-shore, dominated by a grand cluster of the Royal Fern; immediately beyond is a steep bank, which overhangs the water as a miniature cliff. In this spot the Heaths are at home; growing together, and all in flower, we get the Common Heath, the Cross-leaved Heath, the Ling, the beautiful St. Dabeoc's Heath, and the extremely rare Mackay's Heath; also the trailing stems and shining evergreen leaves of their ally, the Bear-berry.

Here we have a good representation of that group of lovely plants of which the Heaths serve as a type—the Natural Order **Ericaceæ**. This is a large Order, comprising some 1300 species, which live chiefly in temperate regions. Most of them are of shrubby growth, and the Order includes a large number of beautiful plants, notably the Heaths and Rhododendrons, which are justly held in high esteem by the horticulturist. The Order is characterised by the curious anthers of the flowers, which open by pores at one end, and often bear strange horned appendages. On this wet rocky slope an unusual variety of Heaths and their allies flourish. We may with advantage commence our detailed examination of the bog flora with these plants. Several of them are familiar to all —the **Ling, Calluna Erica**, with its tiny imbricated leaves arranged in four close rows on the stem, and racemes of small pink drooping flowers. Examine a flower carefully. What at first sight might be taken for the calyx is really a group of two pairs of small green bracts. The calyx is coloured pink, and consists of four sepals, united at the base. The corolla is only about half as long as the calyx; like it, it is pink in colour and deeply four-cleft. As in some other plants of the Order, these floral leaves are very dry and persistent; they rustle when shaken, and remain unchanged, though bleached by winter weather, until the following year. Note the two curious spurs at the base of each anther. The fruit is a little globular capsule, opening by four valves. Equally familiar is **Erica cinerea**, whose purple bells are so dear to every lover of the moor and mountain:—

> " Those wastes of heath
> Stretching for miles to lure the bee;
> Where the wild bird, on pinions strong,
> Wheels round, and pours his piping song,
> And timid creatures wander free."

Note the glabrous leaves, in whorls of three; the flowers, in racemes or terminal umbel-like clusters; the monopetalous egg-shaped corolla, opening by a very small toothed mouth; the toothed appendages of the anthers. The third common species here is the closely-allied **E. Tetralix**, or **Cross-leaved Heath.** It is at once known by its spreading leaves, four in a whorl, and its downy foliage, sepals, and ovary; the drooping flowers are borne in terminal umbel-like racemes, and are large and pink. The whole plant is covered with gland-tipped hairs. **E. Mackaii,** which grows around us here as abundantly as any of the others, is an extremely rare plant; indeed, if we leave the vicinity of Roundstone, the only other places where we will find it are the provinces of Castile and Asturias in Spain. This is the first example we have met of that strange group of southern plants which extend along the west coast of Ireland, a point to which it will be necessary to return later on. This Heath, named in honour of Dr. J. T. Mackay, author of *Flora Hibernica*, has been variously considered a variety or sub-species of *E. Tetralix*, a hybrid between *E. Tetralix* and *E. ciliaris*, or a separate species. The fact that *E. ciliaris* is absent from Ireland effectually disposes of the hybrid theory, so that its rank as a species or variety becomes a matter of opinion rather than of demonstration, depending on the amount of distinctness which botanists may consider necessary to entitle a plant to specific rank, and this is, indeed, a variable quantity. *E. Mackaii* is certainly closely allied to *E. Tetralix;* yet, as we look across the bog in front of us, and along the lake-shore, we can pick it out at a glance by its more deeply-coloured flowers, which, like apples, are often sunburnt on one side, varying in colour from deep rose to pale pink. Its habit of growth, too, is different, for it is more bushy than *E. Tetralix*, and prefers rather drier ground, growing on the slopes with *E. cinerea* and St. Dabeoc's Heath, rather than in the wet flats that *E. Tetralix* loves. In minuter characters it differs in its broader, more spreading leaves, glabrous above, with longer hairs on the edges, broader glabrous calyx-segments, wider corolla, and glabrous capsule.

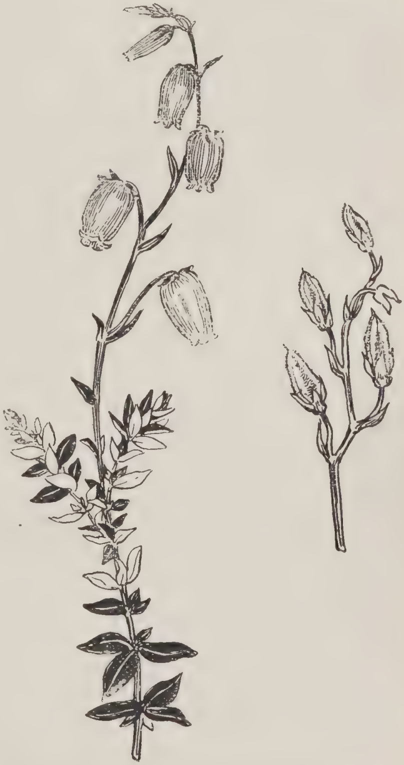

Fig. 29.—St. Dabeoc's Heath, *Boretta cantabrica.* Two-thirds natural size.

With some relief we turn from this puzzling and critical plant to the beautiful and unmistakable **St. Dabeoc's Heath, Boretta cantabrica** (= *Dabeocia polifolia*), whose great purple bells hang on the slope beside us, and nod on the lake-edge to their reflections in the water. This plant is truly one of the glories of Connemara. From Clifden to Lough Mask, and from Galway town to Clew Bay, it grows by roadside and stream, on mountain and in valley. Like *Erica Mackaii*, it is not found elsewhere in the British Isles, and to see it again we must go to the region of the Pyrenees. This is the largest and most beautiful of all the British Heaths. The stem is straggling, and when growing among rank Heather and bushes is often several feet long. The numerous leaves are egg-shaped and pointed, dark green above, densely covered with white wool below. As in several other Heaths, the edges of the leaves curl backwards. The flowers are borne in a lax raceme, and the beautiful bells, half-an-inch in length, droop gracefully. Unlike the Heaths that we have been examining, the corolla of this species falls when flowering is over, and the hairy, egg-shaped seed-capsule then becomes erect (Fig. 29). As early as April I have gathered this plant in full flower, and at the end of August last year it was still abundant.

A few miles southward of our point of observation, where the dark form of Urrisbeg Mountain rises from the heaving bogland, a wide valley runs from the low ground almost to the summit of the ridge. Here, and at only one or two other spots in Western Galway and Mayo (the ancient district of Iar Connaught), there grows in profusion another Heath, of which mention must be made. This is **Erica mediterranea,** the **Mediterranean Heath.** Its growth is erect, bushy, much branched. Even when not in flower, it is easily recognised by its spreading linear leaves, four in a whorl, green on both sides, flat above, convex below. The inflorescence recalls that of the Ling, but the flowers are very different when examined. They have four pointed coloured sepals, which are half as long as the bell-shaped monopetalous corolla, which is four-lobed at the mouth. The cluster of dark brown anthers, projecting slightly beyond the corolla, is conspicuous. This plant is especially interesting as being another of the southern group of which mention has already been made. It ranges along the west coast of Ireland from Urrisbeg to near Belmullet. Nowhere else in the British Isles do we find it, and its Continental home is in the Pyrenean district.

Two other Heaths are found in the British Isles, and their distribution is quite as striking as that of the species last mentioned. These are **E. ciliaris**, which has racemes of large rose-coloured flowers, and leaves fringed with long gland-tipped hairs, green above, glaucous beneath; and **E. vagans**, the **Cornish Heath**, a low shrub with erect woody branches densely clothed with narrow spreading glabrous leaves, and racemes of small axillary stalked pink flowers. Both are found only in the extreme south-west of England, the former in Dorset and Cornwall, the latter in Cornwall only; and outside the British area they are both confined, like the plants to which attention has already been drawn, to the Iberian peninsula.

Growing among the Heaths on the rocky bluff on our left is the **Bilberry** or Whortleberry, **Vaccinium Myrtillus**, differing from the Heaths in its fruit especially, which takes the form of a pulpy berry, and is inferior, while the fruit of the Heath tribe consists of a dry superior capsule. The Bilberry need hardly be described, it is so well known—in fruit at least; the pretty pink hanging flowers, shaped somewhat like those of the Lily-of-the-Valley, are less familiar, as they bloom early and hide modestly among the light green leaves. Note the peculiar anthers, each of the two lobes having a conspicuous horn on the back; the deciduous serrate leaves, quite a rarity in this Order of shrubby evergreens. Closely allied is **V. uliginosum**, the **Bog Whortleberry**, which has leaves with entire margins and glaucous below, and the flowers in clusters. It is found on mountain bogs in the north of England and in Scotland. The remaining two British species of *Vaccinium* are small evergreens. **V. Vitis-Idæa**, the **Cow-berry**, is a tiny mountain shrub, growing on heaths and rocky places, often at high elevations. It has dark green, shining, obovate leaves, with the margins rolled back and the under side dotted with glands. The flowers grow in terminal drooping clusters, and are very pretty. The corolla is pink and bell-shaped, split at the end into four reflexed segments. The fruit is a dark red berry, and is much used in Northern Europe as Cranberries are, and, indeed, is often sold under the name of Cranberries in the London market. Closely allied to *Vaccinium*, and often placed in that genus, is **Schollera occycoccus**, the **Cran-**

berry, which inhabits wet sphagnous bogs, where it often grows in immense profusion. It is one of the most delicately graceful of British plants. The stems are very long and trailing, wiry, and as thin as thread. The tiny leaves are upright, dark green above, the edges much rolled back and half hiding the white under side. The flowers are borne on erect very slender peduncles. They are bright rose-red, and the corolla is cleft into four lobes, which bend back and render conspicuous the ring of eight stamens, with their purple filaments and yellow anthers. The large berries are at first greenish, then red, and they are much used for food in the northern countries where the plant grows plentifully.

One other member of the *Ericaceæ* is here. This is the **Bear-berry**, **Arctostaphylos Uva-ursi**, a trailing evergreen shrub that hangs over a dry rock by the lake-side. The leaves, like those of the Cow-berry, are ovate and shining; both resemble those of the Box. The flowers are pretty, waxy, pink bells, shaped like those of the Bilberry, but the ovary is superior. The anthers have conspicuous reflexed appendages. The fruit is a bright red berry. Another species of Bear-berry, **A. alpina,** grows on mountains in the North of Scotland. Its leaves are deciduous, twice as long as those of *A. Uva-ursi*, wrinkled and serrate, and the berries are black. Both species are distinctly northern and alpine in their distribution; they are found in Scandinavia, in the arctic portions of Asia and America, and on the high mountains of Central Europe. Allied to *Arctostaphylos*, but distinguished by its fruit covered with tubercles, and by the *many* seeds in each of the five cells which it contains, is **Arbutus Unedo**, the well-known **Strawberry-tree**, whose evergreen foliage and pretty rough red berries make it so great a favourite in shrubberies. This species is another of the group of southern plants that we have been finding on the west coast of Ireland. It grows wild on the mountains of Kerry and South-west Cork, and its foreign distribution ranges from the Pyrenean region along the basin of the Mediterranean eastward to Turkey.

The remaining shrubby British *Ericaceæ* are three in number. **Andromeda Polifolia** is a plant of peat-bogs. The stems creep, with short erect branches. The leaves are about an inch long, elliptic and pointed, glabrous, thick, dark green and shining above, glaucous below, the margins much recurved. The flowers are pink and waxy, and bell-shaped like those of *Arbutus* and *Vaccinium.* It is distinguished from other genera of the Order by its dry capsule with five cells and five valves. **Bryanthus taxifolius** (= *Phyllodoce cærulea*) is extremely rare, having been found only on the Sow of Atholl in Perthshire. Its branches are thickly covered with dark green, flat leaves, glabrous on both sides, like those of the Yew, from which it derives its specific name; the nodding pinkish-lilac flowers are borne in a terminal cluster on slender erect peduncles. Lastly, there is **Loiseleuria** (=*Azalea*) **procumbens**, which is not uncommon on the Scottish mountains. It is a tiny, matted, prostrate shrub, with flowers which have a five-cleft red calyx and a five-cleft pink corolla.

Two other genera there are of British *Ericaceæ*, by some authors placed in a separate Order—the beautiful **Wintergreens, Pyrola** and **Moneses.** The former genus are herbaceous plants with creeping stems, which bear tufts of round, glabrous, evergreen leaves, and one-sided racemes of white waxy flowers with five incurved petals. There are four species of *Pyrola*, which are distinctly like each other—*P. rotundifolia*, *P. media*, *P. minor*, and *P. secunda.* The points of difference lie chiefly in the stamens and style, which are of different length and shape. Closely allied to *Pyrola* is *Moneses grandiflora*, easily distinguished by its large *solitary* flowers and conspicuous five-pointed starlike stigma.

Before leaving the Heath family we must refer to one of the strangest of British plants, which is allied to *Pyrola*, and by some authorities is placed in the same Order. This is the **Yellow Bird's-nest, Hypopitys Monotropa,** a pallid leafless plant, much resembling in appearance the parasitic Toothwort or Broomrape, and growing in woods. In the structure of the flowers it differs from *Ericaceæ* in the fact that the anthers open by a transverse fissure instead of by pores. The root consists of a dense mass of fleshy fibres, from which arise the yellowish flower-stems clothed with scales, and bearing dingy yellow blossoms in a drooping raceme. How does this plant obtain its food supply? It is destitute of chlorophyll, so that there is no possibility of assimilation from the atmosphere. Though growing among the roots of trees, it does not attach itself to them, and is not parasitic like the Toothwort. The explanation is very curious. If we dig in the vegetable mould under trees, we frequently find a mass of fine whitish threads like a cobweb. This is the *mycelium* or underground portion of a fungus. The aërial fructification of such plants we are familiar with; they constitute the Mushrooms and Toadstools of our meadows and woods. The coral-like root of *Hypopitys* is always found associated with a mycelial mass of this kind; so closely interwoven are they that the tissues of flowering plant and fungus are actually continuous, and cannot be distinguished;[1] and there appears to be little doubt that the *Hypopitys* is truly parasitic on the fungus, drawing from it the organic substances required to build up its stems and flowers and fruit. The fungus, in its turn, is a *saprophyte*, living, like certain flowering plants, on the organic compounds of the decaying leaf-mould, and therefore not requiring to manufacture them with the assistance of light and chlorophyll. Like the Toothwort and Broomrape, *Hypopitys* bears numerous tiny seeds. These get scattered over the ground, and some of them will probably come in contact with a fungus-mycelium, and the curious relationship will be renewed.

But we must return to our bog-plants. At the foot of the Heath-covered slope is a soaking patch of sedgy plants and green and red *Sphagnum* and brown peat-mud. Its edge overhangs the lapping waves of the lake, and the streamlet which oozes across it trickles down the withered hanging grass-leaves, and drips in silvery threads into the deep-brown water below. This marsh, which quakes as we crawl cautiously across it, ankle-deep in moss and water at every step, is the chosen home of several interesting and lovely little plants—of the Bog-Asphodel, the Butterwort, and the Sundew. The **Bog-Asphodel, Narthecium Ossifragum,** has a creeping root-stock, which bears a flattened tuft of sword-shaped leaves like a miniature *Iris*, and a taller flower-stem, on which is borne a raceme of deep yellow star-like blossoms. Note the single six-parted perianth, the six stamens, with scarlet anthers and densely woolly filaments, which contribute largely to the peculiar appearance of the flower. The pistil tapers to a point. It elongates in fruit till it exceeds the perianth-leaves, which then clasp it closely. The seeds are very small, with a long tail at each end. This is an elegant little plant, and to see it as one does here, covering acre upon acre with its bright yellow stars, is indeed a pleasant sight. The plant derives its specific name of *Ossifragum*—bone-breaker—from an unmerited suspicion that it brought on in sheep the disease of rot. It is the only known species of the genus. The affinities of the plant are with *Liliaceæ* and *Juncaceæ;* by some botanists it is placed in one or other of these Orders; by others, along with a few allied plants, in a separate Order, *Melanthaceæ*.

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[1] Kerner, "Natural History of Plants," i. p. 253.

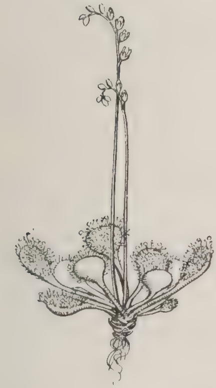

FIG. 30. — ROUND - LEAVED SUNDEW, *Drosera rotundifolia.* Half natural size.

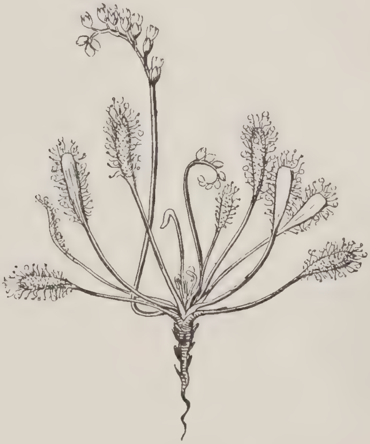

FIG. 31.—INTERMEDIATE SUNDEW, *Drosera intermedia.* Half natural size.

Let us next turn to those fascinating little plants, the **Sundews.** There are three British species—*Drosera rotundifolia, D. intermedia, D. anglica*—and in our little marsh they grow together. All are tiny plants, a few inches in height; all bear a radical cluster of rather fleshy green leaves set with long bright-red dew-tipped hairs; and all have wiry upright flower-stems, bearing a raceme (which is curled when young) of small white blossoms, which one hardly ever sees open. The three species are easily distinguished (see Figs. 30, 31, 32). **D. rotundifolia** is known by its round leaves, which lie almost flat on the ground. **D. intermedia** has spoon-shaped erect leaves, twice or three times as long as broad, and is especially distinguished by its flower-stem, which springs from the base of the leafy portion of the stem, and is horizontal in its lower part, then erect. **D. anglica** is the largest British species, with upright leaves about six times as long as broad, and taller flower-stems, which rise erect from the centre of the rosette of leaves. *D. intermedia* is the only one of the three that usually possesses a distinct stem; this is often one to two inches long, and clothed with the rotten leaves of former seasons. The supreme interest of *Drosera* lies in the red hairs which cover the upper surface of the leaves. Each hair is tipped with a sparkling drop of gummy fluid. If we examine a few leaves carefully, we find entangled among the hairs the bodies of small insects. If we place a small insect on an expanded leaf, we witness the strange sight of the hairs closing over it until it is securely entrapped; and elaborate experiments have proved that the glands of these wonderful hairs actually digest the animal matter which is captured by a process apparently very similar to that by which digestion is carried on in animals. Darwin fed plants of Sundew with morsels of roast meat and boiled white of egg, placing similar pieces on wet moss. Those on the moss putrefied, while those on the Sundew were dissolved. That the plant actually thrives on the animal food absorbed has been abundantly proved by the experiments of Francis Darwin, who fed a number of *Drosera* plants with roast meat, while other plants in the same dishes were kept unfed. In a

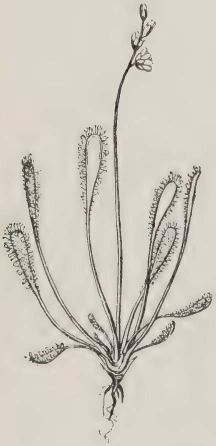

FIG. 32.—LONG-LEAVED SUNDEW, *Drosera anglica.* Half natural size.

few months the fed plants were larger and in every way strikingly more healthy than the unfed ones. The sensitiveness of the tentacles is very extraordinary. A morsel of a woman's hair, weighing only $\frac{1}{78740}$ of a grain, laid on a leaf, was sufficient to produce movement. Charles Darwin found that the hairs were marvellously sensitive to salts of ammonia. The immersion of a leaf in a solution so weak that each gland could absorb only about one twenty-millionth of a grain, produced complete inflection of the tentacles. "The hairs or tentacles, then," says Professor Geddes in his charming "Chapters on Modern Botany," "are sensitive, mobile, digestive, and absorptive — most marvellous little structures, indifferent to the drops of rain which often fall upon them, but responsive to the stimulus of a midge. An insect, unwary or deluded, alights on the leaf, and is forthwith entangled; as it struggles, the secretion becomes more abundant. The tentacles, too, bend down upon the entangled midge; first one, and in a few minutes another and another, till all the two hundred may close upon the prey like so many slow, merciless fingers. The leaf may become more concave, and after complete closure looks like a closed fist. As the result of the secretion, the booty is digested and the products of digestion absorbed."

Growing near the Sundews our eye catches the rosette of yellow-green tongue-shaped leaves which belong to **Pinguicula vulgaris**, the **Common Butterwort.** The Butterworts have been already referred to as allied to the Bladderworts (*Utricularia*), and with them constituting the British representatives of the **Lentibularieæ.** The Bladderworts, it will be remembered, capture small animals by means of a kind of mouse-trap arrangement. The Butterworts are also carnivorous, but their fly-catching mechanism resembles rather that of the Sundews. The smooth leaves exude a viscid fluid by means of numerous stalked and unstalked glands. When an insect alights on the plant, it is held fast by the gummy secretion; the incurved edge of the leaf then slowly rolls forward, securely enclosing the victim. The glands have the power of digesting the food thus captured, like those of *Drosera.* A striking point in connection with both these genera is their different behaviour according as the substance which comes in contact with the glands is organic or inorganic. Grains of sand produce no change in the nature of the secretion, but the smallest fragment of meat or other nitrogenous substance at once causes the exudation of copious mucilage, and also of a highly-acid secretion, which can dissolve even pieces of cartilage. As in the case of the tentacles of Sundew, the Butterwort leaves, after closing on an insect, remain closed for a period, and then slowly unfold and await a fresh victim.

To return to our *Pinguicula*. In the centre of the rosette of leaves rise several slender flower-stems. Each arches over at the top and bears a pretty two-lipped purple flower, its irregular corolla extended backwards into a spur like that of the Violet. Unlike the flowers of its allies the Bladderworts, the lips are not in contact, but gape slightly, the throat being hairy within. In fruit, the stem becomes erect, and the conical capsule is clasped below by the persistent calyx.

Four species of **Pinguicula** are found in the British Islands. *P. vulgaris* is by far the commonest. **P. grandiflora** is by some authorities considered a sub-species of the last. Its beautiful large flowers, an inch across, differ from those of *P. vulgaris* in their short, broad, overlapping corolla-lobes, and the whole plant is larger. It grows very abundantly in Cork and Kerry; elsewhere it is found in the Iberian peninsula and the Alps. **P. lusitanica** is a small plant, with pale veined leaves, the margins much incurved, and pink short-spurred flowers. It grows in bogs in South-western England, Western Scotland, and throughout Ireland. Its foreign distribution is Western France, Spain, Portugal. The last species is **P. alpina**, a rare Scotch plant, found in Skye and Ross, resembling a large *P. lusitanica*, with a longer lower lip and a shorter spur. It has a wide distribution in northern latitudes.

Forming a straggling mat in the middle of the marsh is one of the smallest of the **St. John's-worts, Hypericum elodes.** Most of the St. John's-worts are shrubby plants inhabiting dry woods and banks; but this species loves the wettest of wet places. The stems are long and trailing, rooting below, ascending above, and shaggy with hair, as are the opposite pairs of sessile roundish leaves. The flowers are borne in little clusters on the summit of the stem, or spring from the axils of the upper leaves. Like all the St. John's-worts, they have five sepals, five spreading yellow petals, and many stamens, which latter are in this species borne in three sets, each set shaped like a hand, and with a petal-like scale between each. The ovary is surmounted by three styles, as in all our native members of the genus. The plant has a strong resinous odour, in which it agrees with several others of its tribe. We shall have occasion to return to the St. John's-worts in a future chapter (p. 152).

The little lake, as we have seen, is set in glowing Heather and lichen-patched rocks. The Heather grows right down to the water's edge, which it overhangs in a luxuriant fringe of purple and brown. The surface of the water is broken by great rugged boulders, three-quarters submerged, and tall groves of Reeds and Twig-rush, and patches of white Water-Lilies. Among the waving Reeds the Water-hens utter their sharp alarm-note, and a Dabchick skulks in the Water-Lilies, its dark head alone showing above the surface. If we scramble to that rocky point, where sunken boulders act as a breakwater to the ripples and leave the surface behind them smooth as a mirror, we can peer down through the clear water and study the aquatic flora of our lakelet. The peaty bottom is covered with a verdant carpet of vegetation like a submerged grass-plot. Three plants are here, growing together—*Lobelia Dortmanna, Littorella juncea, Eriocaulon septangulare.* The pretty **Water-Lobelia, L. Dortmanna,** is well known to the mountaineer, who finds its nodding flowers shaking over the wavelets of lonely tarns. The rosette of narrow linear leaves is always submerged, and the plant favours water about a foot in depth. The leaves may be known from those of any other British water-plant by their backward curve, and by being composed of two tubes, as seen when a leaf is cut across. From the centre of the rosette rises the tall unbranched hollow flower-stem. Its height depends on the depth of the water; it lengthens until the lowest flower is well above the surface. When growing in water three feet deep, as the plant occasionally does, it appears to wisely relinquish the attempt to gain the atmosphere, as a feat beyond its strength, and does not flower. The pretty pale lilac flowers are borne in a lax raceme. The calyx is short, the corolla tubular below, divided above into five lobes, and rather two-lipped, the upper lip being composed of two segments, the lower of three larger ones. Note the five anthers, fused together like a ring round the style; in this particular, and in its irregular corolla, *Lobelia* differs from all the other **Campanulaceæ**, to which Order it belongs. The only other British *Lobelia* is **L. urens**, a terrestrial plant found sparingly on heaths in the south-west of England. In Europe it grows in France, Spain, and Portugal.

Littorella juncea, the **Shore-weed,** has already been referred to (p. 17) in treating of the Plantains, to which it is allied. But it differs from them in many respects. The root-stock sends out long runners, which produce new plants as those of the Strawberry do. The leaves are narrow, fleshy, pointed. Instead of having a dense spike of perfect flowers, as the Plantains have, the male flowers are borne singly on slender stems, and the female are quite sessile down at the bases of the leaves. The male flowers have a regular four-cleft green calyx, and a regular four-cleft white corolla, and four stamens on exceedingly long filaments, three or four times as long as the corolla. The female flowers have a calyx of three unequal sepals, a tubular corolla, narrowed above and below, and an exceedingly long, slender style. This is a common little plant, growing on the margins of lakes both in and out of the water, but generally flowering only when in the air or in very shallow water. It is the only known species of the genus. The leaves may be distinguished from those of *Lobelia*, which they resemble, by being not tubular, sheathing at the base, and not flattened or recurved in the upper part.

With these two plants grows the **Pipewort, Eriocaulon septangulare.** Its appearance is well shown in the drawing (Fig. 33), made from a specimen collected at the spot at which, in fancy, we stand. The soft root-stock creeps, giving out numerous long, white, fibrous, jointed roots below, and at the extremity a tuft of short, grassy leaves, which are pellucid and very cellular. The scape is long and slender, with six to eight raised lines, usually seven, from which the plant derives its specific name. Like those of *Lobelia*, the stems lengthen till they rise above the surface; they bear a dense tuft of very small mottled white and black flowers, like a little pin-cushion. The flowers in the centre are male, those round the edge female. Each flower has two hairy sepals and two fringed petals, and either four dark stamens, or a tiny green ovary surmounted by a forked style. The distribution of this peculiar little plant must be specially noted. In our lakelet it grows everywhere, and it literally swarms in the innumerable lakes of Connemara. It is found as far south as the extremity of Kerry, and as far north as Donegal. In Scotland it grows in Skye and a few neighbouring islands. It is found nowhere else in the British Isles or in Europe, and in Asia we search for it in vain; but in North America it is widely distributed.

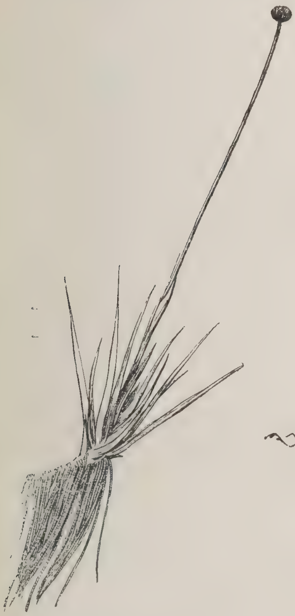
FIG. 33.—PIPEWORT,
Eriocaulon septangulare.
One-third natural size.

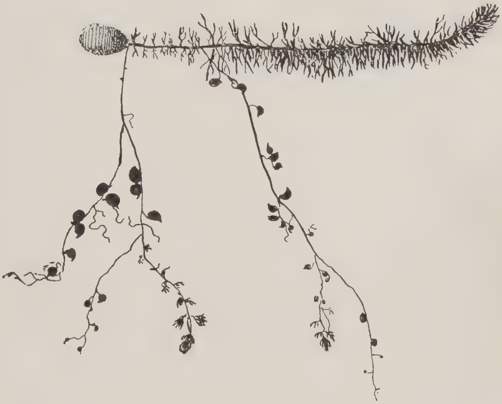
FIG. 34.—INTERMEDIATE BLADDERWORT,
Utricularia intermedia.
Half natural size.

Close by, in a sheltered little bay, on a soft, peaty bottom, the **Intermediate Bladderwort, Utricularia intermedia,** grows in great abundance. It will be remembered that these interesting carnivorous plants were described in a former chapter (p. 67), and that *U. intermedia* (Fig. 34) is distinguished from the others by bearing the leaves and bladders on separate branches. While the other British Bladderworts usually float, this species lives on the bottom. The flattish, green, leafy shoots spread over the surface of the peaty bottom; the pale, bladder-bearing branches burrow deeply in the soft mud like roots, and anchor the plant securely.

It will have been noticed that in the present chapter the range, both in the British Isles and on the Continent, of many of the plants mentioned, has been defined, and this has been done with a definite reason. The study of the **distribution** over our globe of plants and animals is at all times fascinating, and this West Irish flora in particular offers some problems of surpassing interest to the student of geographical distribution. Let us briefly recapitulate what we have learned from the plants that grow around our lakelet. Several Heaths, *Erica Mackaii*, *Boretta cantabrica*, and over on the slope of Urrisbeg yonder *E. mediterranea*, all found in Connemara, and none of them elsewhere in the British Isles, are in Europe confined to the Spanish peninsula and the adjoining portion of France. Two other Heaths, *E. vagans* and *E. ciliaris*, found only in the extreme south-west of England, have a similar European range; and the same remark applies to *Lobelia urens*. The beautiful *Arbutus* of Killarney ranges all along the Mediterranean. *Pinguicula grandiflora*, abundant in Cork and Kerry, is confined to South-west Europe and the Alps. *P. lusitanica*, with a wider but still a *western* distribution in the British Isles, is on the Continent confined to the south-west. If we go beyond the plants which happen to have been mentioned in this chapter, we get numerous other instances of South-western European plants also found in Western Ireland. Such, for instance, are the London Pride, *Saxifraga umbrosa*, and the Irish Spurge, *Euphorbia hiberna*, in Ireland ranging from Donegal down the west and south to Co. Waterford; elsewhere confined to South-western Europe, *E. hiberna* occurring also in Devonshire; two other Saxifrages, *S. Geum* and *S. hirsuta*, found in Cork and Kerry, elsewhere in the Pyrenean district only; and *Simethis bicolor*, found in Kerry, formerly in Dorsetshire, and across France and Spain to Sardinia and Corsica. Over yonder, across Galway Bay, where the grey limestone terraces of Clare rise high over the ocean, grows abundantly the little Close-flowered Orchis, *Habenaria intacta.* We shall not meet with it again till we reach the neighbourhood of Nice, on the sunny shores of the Mediterranean. The instances quoted abundantly show that along the west coast of Ireland there is found a well-marked group of plants which have their headquarters in the Spanish peninsula or the basin of the Mediterranean, and which are unknown in Northern Europe and in Scotland and England, with the exception of a few which appear in Cornwall, Devon, and Dorset. And this remarkable feature of the West of Ireland flora is accompanied by other phenomena of distribution more startling still. *Eriocaulon*, which abounds in the little lake beside us, and is found along the west coast from Donegal to Kerry, and in the Hebrides, is, as we have seen, found nowhere else outside North America. Over yonder to the southward, across the ridge of Urrisbeg, lies the little lakelet called Craigdhu Lough. In this lake, and in the lakes of Killarney and Cara in Kerry, grows a little hydrophyte, *Najas flexilis*, a slender branched plant, found also in Scotland and on the Continent, but in the main an American species. More striking is the evidence given by the beautiful orchid *Spiranthes Romanzoviana* (see title-page), which grows in Cork, Armagh, and Londonderry, nowhere else in Europe, and is widely distributed across the northern portion of North America, and just crosses Behring Sea into Kamtschatka. Equally remarkable is the range of the "Blue-eyed Grass," *Sisyrinchium angustifolium*, a little Iris-like plant, which grows near Woodford in Co. Galway in profusion, and in Co. Kerry, and is otherwise entirely a North American species, save where it has been introduced in a couple of places on the European continent. It is to be noted that all these American plants are decidedly northern or sub-arctic forms. Then, as if to make this curious mixture of northern and southern strangers more striking, a number of alpine plants, which in the British Isles usually haunt the crags of the mountains and high moors, in the West of Ireland grow right down to sea-level, and commingle with the Mediterranean species. Thus, over there on the grey limestone coast of Clare, the Mediterranean *Habenaria intacta* grows in a carpet of Bear-berry, Mountain Avens (*Dryas octopetala*), Spring Gentian (*G. verna*), and Blue Moor-grass (*Sesleria cærulea*). And here by our Connemara lakelet, as we have seen, the Pyrenean Heaths, *Boretta cantabrica* and *Erica Mackaii*, fringe the water in which grow the alpine *Lobelia* and the sub-arctic American Pipewort. The accompanying sketch-map, made by Dr. Scharff to illustrate the various elements of the fauna of the British Isles, will convey also a good impression of the distribution of the elements of our flora. From it we see clearly that, while the greater part of England is tenanted by species which had an eastern origin, northern forms are spread over Scotland and down the west coast of Ireland, where they meet and overlap the southern species which have their headquarters there.

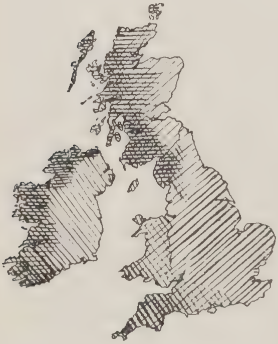

FIG. 35.—MAP SHOWING THE CHARACTER OF THE FAUNA OF THE BRITISH ISLES.

▨ Eastern species.
≡ Northern species.
▧ Southern species.

In order to appreciate the full significance of the facts which have been now detailed at some length, it is necessary to consider the elements of the laws which govern the **dispersal** and present **distribution** of our common plants.

These islands were colonised, as is natural, chiefly by plants that came from the great land area to the eastward. Asia appears to have been a centre of distribution of enormous fertility and importance for both animals and plants. Thence came the races of ruminants and carnivores that still inhabit the countries of Europe and our own islands, and later the hordes of hardy men who swept, wave upon wave, across the European plains. And so races of plants have spread westward, ever driven forward by the pressure from behind, where newer and stronger forms were continually usurping their place and crushing them out. The march of the plants was probably slow and steady. Cases we have already seen, and others might easily be quoted, of species, accidentally or deliberately introduced, spreading like wild-fire, and traversing by leaps and bounds the length and breadth of the land. But these are exceptions, and the plants which performed such feats exceptional. The particular geological periods at which the various migrations and invasions occurred, and the changes of climate which have no doubt obtained in Europe in comparatively recent times, and the great effect these must have had in moulding the present flora, are questions too large and too technical to be entered on here. It will be sufficient to indicate roughly some of the relations between our present flora and geographical changes which have taken place in what, in the history of the world, were very recent times. The great similarity between the English flora and that of France and Germany is due to the former land connection that existed where now the German Ocean and Straits of Dover lie. But that this old land was invaded by the sea a long time ago is apparent from the absence in England of many common and hardy Continental species, which, it may be presumed, arrived too late to cross the former land-bridge. Similarly, many of the commonest English wayside plants are unknown in Ireland—such as the Black and White Bryony, the Wayfaring-tree, the Needle-Furze, the Hairy Buttercup. To put the statement in general terms, the European flora exhibits a diminution of species on the western islands, due chiefly to the breaking-down of land-connections prior to the arrival of the whole of the present flora. Exactly the same phenomena, it may be added, are found among our animals, and here some of the absences in Ireland are so striking that they point strongly to the conclusion that the land-connection with England must have been severed before these animals—such as the Voles, the Mole, the Common Toad—reached England from the Continent. Across the old land surface, too, where now stretches the shallow German Ocean, northern plants reached Scotland, and thence Ireland.

So far we are on tolerably safe ground. But when we endeavour to account for the peculiar flora of Western Ireland, we are confronted with problems much more difficult, and on that account more fascinating. The curious fact of the occurrence of plants which are usually high alpines, at sea-level, has generally been attributed to the excessive moisture of the climate, which, it is held, supplies, in the main, the conditions necessary for the growth of these species. But how are we to account for the conspicuous group of Pyrenean and Mediterranean plants, absent from the whole of the route by which most of our flora arrived from the Continent, and unknown in equally high latitudes in any other part of the world? And what is the explanation of the presence of the peculiar group of American species which have their European headquarters on the west coast of Ireland, while a few of them spread into Scotland, or to a few stations on the Continent? Theories have not been wanting that the Pyrenean plants are the legacy of Spanish invasions of and intercourse with Ireland during the last thousand years; that the American species were accidentally brought over by ships, or their seeds wafted across the ocean by westerly gales or by the Gulf Stream. But the distribution and habitats of the plants themselves disprove such assertions. The Blue-eyed Grass, it is true, *may* have been introduced; suspicion has been showered upon it abundantly, and the case against it has recently received confirmation by the discovery of another American *Sisyrinchium*, *S. californicum*, growing abundantly and looking quite wild in marshy meadows near Wexford, where even the discoverer does not venture to claim it as an original native.[1] But the occurrence of one plant which is doubtfully indigenous does not invalidate the general case.

Nor is it to the flora alone that we must look for evidence of the Pyrenean and American flavour of the natural history of Western Ireland. The animals tell us the very same story. The Kerry Slug, so well known to students of the Mollusca, is found elsewhere only in Portugal; and among the spiders, butterflies, beetles, earthworms even, instances of the same strange connection have been discovered.[2] And recently, the American element has been unexpectedly augmented by the discovery in the west of Ireland of no less than three North American fresh-water sponges, which are unknown in the rest of Europe.[3]

[1] E. S. Marshall, *Journal of Botany*, xxxiv. 366 (1896).

[2] See G. H. Carpenter, *Irish Naturalist*, v. 62 (1896).

[3] R. Hanitsch, *Irish Naturalist*, iv. 122 (1895).

There appears little doubt that the presence of these plants and animals in Ireland points to changes so vast and periods so remote, that one stands amazed at the tales of time and change which they suggest. Yet we know that the solid land is in a state of ceaseless unrest, that continents have come and gone, that the whole surface of the globe has ever been rising and sinking and crumpling under the action of mighty forces within; that again and again the sea has flowed over the land and ebbed again; that the ocean is eternally eating away the land, the rivers eternally forming new land beneath the waves. And these stranger-plants give us more particular evidence of former land areas where now all is deep sea.

That gifted naturalist, Edward Forbes, who first attempted a definite solution of this problem,[1] concluded that the southern plants constituted the most ancient group of our flora, and were the remnants of a vegetation which flourished on a vanished continent that in Miocene times connected Ireland with Portugal and stretched southward to the Azores. More recent research has led to a modification of Forbes's theory, but naturalists are in general agreement that a former extension of the western coast-line of Europe allowed these southern plants to migrate over land, long since submerged, to Ireland, where, aided by the mild and equable climate, they have remained to tell us of vanished lands.

A similar hypothesis appears necessary to explain the presence of the North American species on our western shores. The late A. G. More has expressed, with no uncertain voice, his opinion on the origin of the plants of this group. "These may be considered as the remains of a former land-connection with America, and were probably driven southwards during the glacial epoch from the shores of Greenland; at any rate, from the land which, at that time, joined America to Europe; and these may be held to be more or less Arctic species, as well as Americo-European."[2]

From the brief account of the stranger-plants of our Connemara scene and their allies, and the speculations as to their past history, we may draw some idea of the importance of including in our botanical studies the question of the distribution of plants. If we want to be *botanists* in the widest and truest sense, it is not enough that we should be able to name each plant, no matter how closely it may approach its nearest ally; nor that we should be familiar with the minute structure of its parts. As Charles Kingsley says:[1] "Young naturalists should act not merely as Nature's registrars and census-takers, but as her policemen and gamekeepers; and ask everything they meet—How did you get there? By what road did you come? What was your last place of abode? And, now you are here, how do you get your living? . . . Such a course of questioning will call out a great many curious and interesting answers, if you can only get the things to tell you their story; as you always may if you will cross-examine them long enough."

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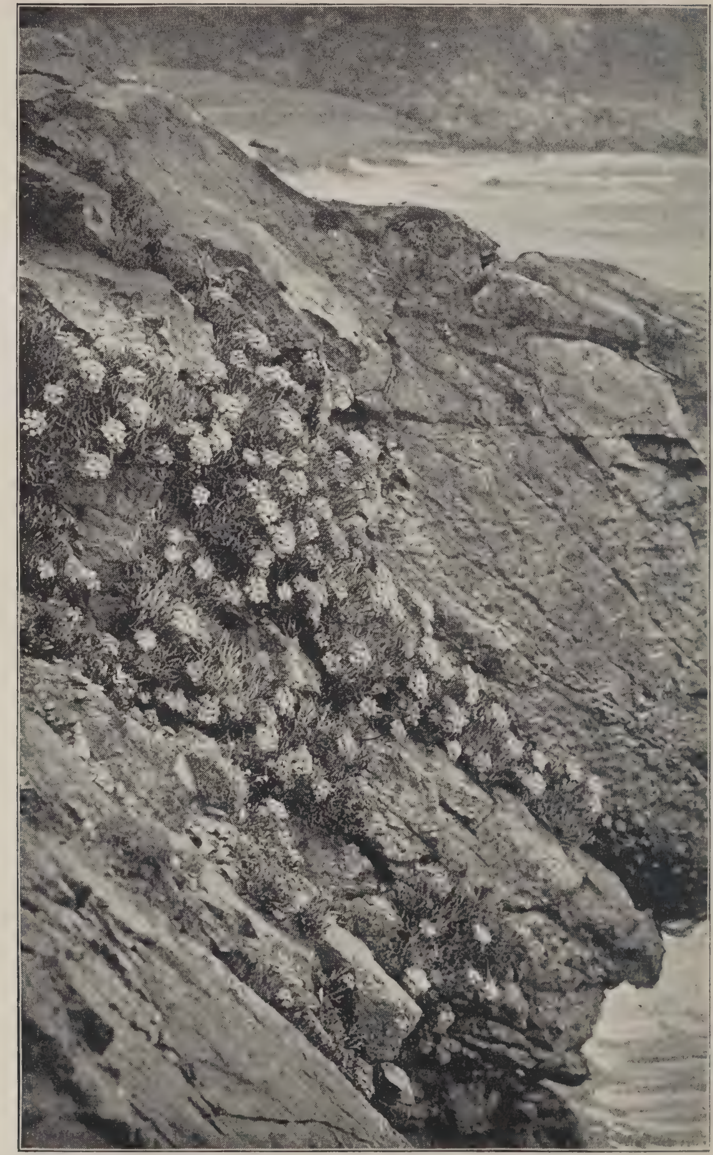
[1] *Memoirs of the Geological Survey of Great Britain*, i. (1846).

[2] *Journal of Botany*, xxxi. 299 (1893).

[1] "Scientific Lectures and Essays: On Bio-geology."



WHERE THE SAMPHIRE GROWS.

HOWTH, CO. DUBLIN, *August* 1896.

PLATE IV.]

SCENE VII

WHERE THE SAMPHIRE GROWS

(Howth, Co. Dublin, *August* 1896.)

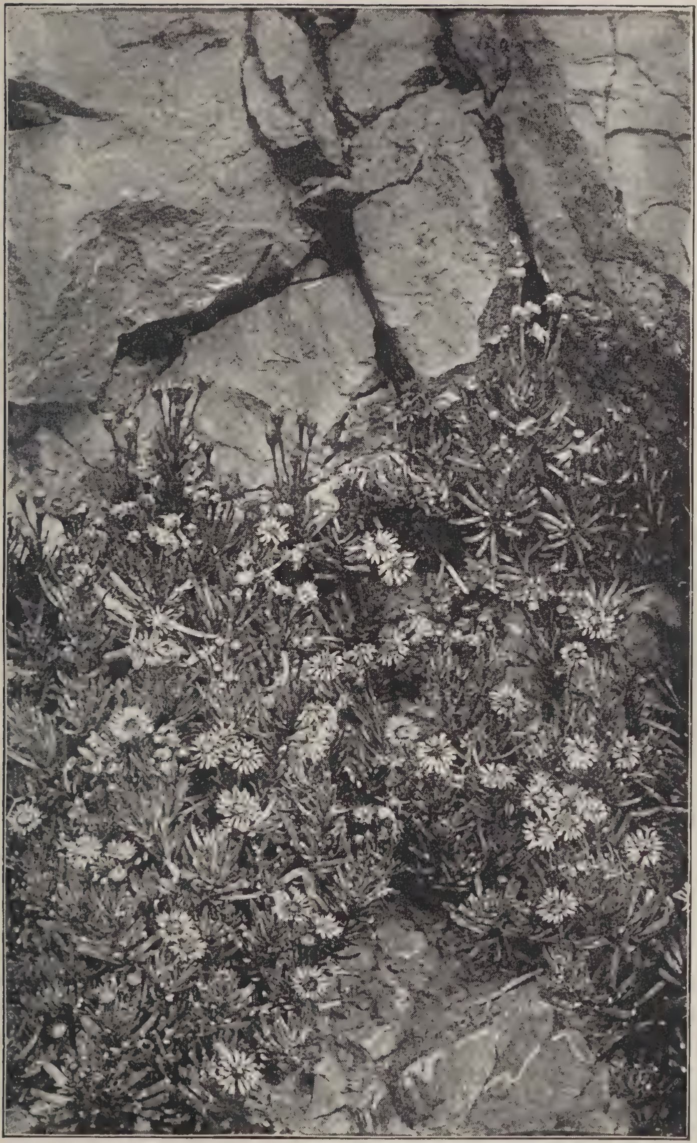
[Plates IV., V.]

We are once again by the sea—not on the gravelly beach which was sketched in an earlier chapter, nor yet on the broad yellow sands, but on that wild coast where the storms beat against the twisted and shattered Cambrian rocks of Howth, and the waves have carved out cliffs and caves, steep headlands, and isolated pillars of rock. Where the hard masses of quartzite face the sea, there the land projects boldly, and yields only inch by inch to the stress of wind and water; but the red and purple slates that intervene are softer, and are cut into fantastic shapes, while beyond the reach of the waves they have weathered into high steep slopes. By climbing down through the low tangles of Bloody Crane's-bill and Madder, and over green carpets of Sea Stork's-bill and Yellow Stonecrop, and grey clusters of Hare's-foot Trefoil, and purple patches of Wild Thyme, we may creep close to the water, where the covering of soil ceases, and plant-life is confined to the cracks and shelves of the rocks, which project in wild masses on every hand and shelter a luxuriant vegetation. To-day there is a brisk easterly breeze, bringing in a bright tumbling sea with white crests, which dashes over the half-sunken rocks and spouts in white columns up the cliffs. The salt mist blows up the slope, and we taste it in the wind, which brings us the fresh smell of the sea. The flora down here is truly maritime, and its members appear to revel in the wind and spray.

These are tough, hardy plants, many of them leathery and fleshy. They are late flowerers, too—to-day is August 15th, and most of them are in full blossom. Filling a deep cleft in the quartzite on the left is the Samphire, and close beside it clusters the rare Golden Samphire, its flower-heads standing out like yellow stars from the dark shining foliage. The Sea-Beet, too, which hides among those fallen blocks below, has glossy and succulent foliage; so has the Scurvy-grass, long since out of flower, and now forming rosettes of shining leaves, ready for the flowering-time which will come next April. The Scentless Mayweed, which, alone of these cliff-plants, is found far away from the sea, becomes more compact and fleshy in situations such as this. No doubt the scanty soil and danger of drought are the reasons of this succulence; the plants store in their tissues a supply of food and water, on which they can draw in times of famine. The other inhabitants of our sea-cliff are mostly compact and tufted. The Sea-Pink grows in dense cushions, and the leathery leaves of the Sea-Lavender form short close tufts, compared to which the tall spreading inflorescence looks disproportionately large. In their habit of growth these resemble alpine plants, such as we shall meet in a future chapter; and that the conditions are similar in many respects is shown by the fact that the Sea-Pink, Scurvy-grass, Sea-Campion, and other characteristic plants of maritime rocks, flourish also on high mountains.

If we scramble down the rocky slope a few yards, we may make a closer acquaintance with these flowers of the sea-rocks. The well-known **Samphire, Crithmum maritimum**, is a striking plant; we know it at once as belonging to the *Umbelliferæ,* but it is not like any other British member of the Order. Its short stout stem is zigzag, giving off much-divided leaves, the segments of which are very narrow, almost cylindrical, and stand upright. The umbels of flowers are greenish-yellow. Most noticeable is the taste of the plant, and its scent when bruised; it is strongly aromatic and pleasant, and in old times was high in favour as a condiment, though nowadays its use is much gone out of fashion.

The **Golden Samphire, Inula crithmoides**, resembles the true Samphire in nothing but its aromatic properties; its scent and taste are remarkably like those of *Crithmum,* considering what a widely different plant it is; for this is an *Inula* or Fleabane, allied to the Daisies and Groundsels—a member of the rayed group of the *Compositæ.* From the summit of its branched woody root-stock it sends up short



GOLDEN SAMPHIRE (*Inula crithmoides*).

HOWTH, CO. DUBLIN, *August* 1896.

PLATE V.]

stems clothed with many undivided, linear, fleshy leaves, which are often three-pointed. The leaves become shorter above, and the stem terminates in one or more yellow flower-heads, with a large disk and rather short, narrow

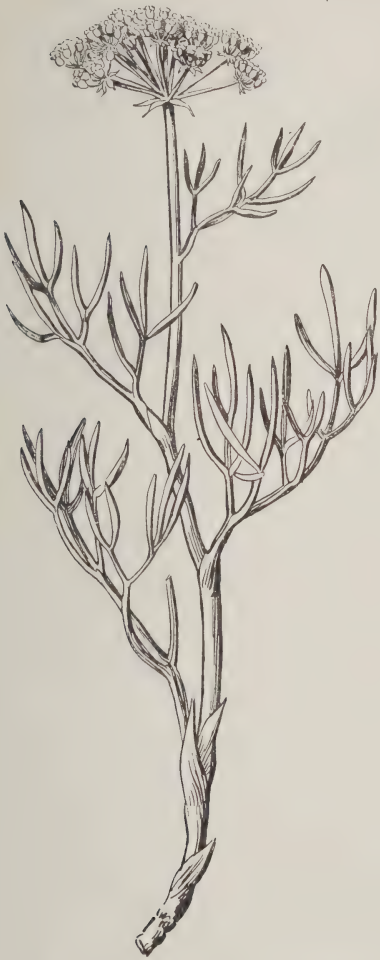


Fig. 36.—Samphire, *Crithmum maritimum.* Half natural size.

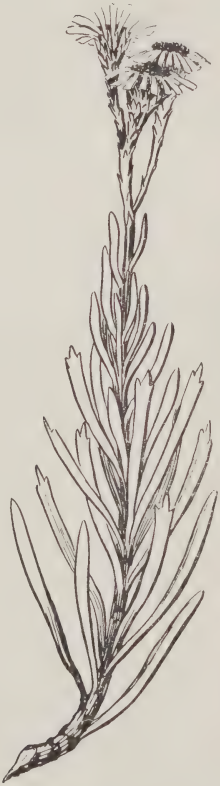


Fig. 37.—Golden Samphire, *Inula crithmoides.* Half natural size.

ray-florets. Below the flower the stem is densely clothed with bracts, which become phyllaries around the flower-head. This species has a limited distribution round our coasts, ranging from Essex along the south and west coasts to Wigtown, and in Ireland along the southern and eastern shores. There are several other British Fleabanes, but none of them resemble *I. crithmoides* in its fleshy foliage and maritime habitat. **I. Conyza**, the **Ploughman's Spikenard**, is a tall, stout, downy perennial, growing in copses and on dry banks, but absent from Scotland and Ireland. The leaves are large and broadly lanceolate, with a serrate margin; the leafy stem terminates in a large corymbose inflorescence. Each flower-head is small, without a ray, the yellow disk surrounded by numerous irregular phyllaries. **I. Helenium**, the **Elecampane**, is not considered truly native in Britain, but it often grows apparently wild, and is one of the boldest and handsomest members of our flora. The lanceolate root-leaves are a couple of feet in height; the thick stems sometimes six feet, branched above, with a few leaves, each branch terminating in a large yellow rayed flower-head three inches across. The phyllaries are very large and leafy. **I. salicina** is in the British Isles known to grow only on the shores of Lough Derg in Ireland. It has a leafy stem resembling those of the accipitrine Hawk-weeds, and one or more yellow rayed flower-heads. The genus **Pulicaria** is closely allied to *Inula*, and is by some authorities included in it. *Pulicaria* differs in having a crown of short scales on the fruit, surrounding the pappus. Two species are found in our islands. **P. dysenterica**, **Greater Fleabane**, is a familiar plant in England and Ireland, but rare in Scotland. It grows in damp pastures. The root-stock is creeping. The upright unbranched woolly stems are clothed with sessile leaves, densely covered with cottony hair; the stems divide at the top, and bear golden-yellow heads of flowers, with a large disk and numerous ray-florets. The scales which crown the pappus are broad, and toothed across their blunt ends. **P. vulgaris**, **Lesser Fleabane**, is a rare South of England annual, found in damp sandy ground. It is a downy branched plant, with oblong leaves and small flower-heads almost devoid of a ray. The pappus-scales are separate and pointed.

Another seaside Composite grows among the rocks here. This is the Sea Aster or **Sea Starwort, Aster Tripolium,** distinguishable from all other British *Compositæ* by its large flower-heads with a yellow disk and purple ray. The leaves are long, lanceolate, smooth; the stems much branched above. The only other native *Aster* is **A. Linosyris,** the **Goldylocks,** found on limestone rocks at a few stations in Western England. It has slender stems with many linear entire leaves and a terminal cluster of small yellow flower-heads destitute of a ray. In North America, which appears to be the headquarters of this genus, many purple-rayed species are found, and several of these have escaped from cottage-gardens in our Islands and established themselves.

The only other British *Compositæ* which have a purple ray belong to the genus **Erigeron,** which is closely allied to *Aster*, differing from it by the flowers of the ray being in many rows instead of in one, and by the fruit being narrower. Two species occur in our Islands. **E. acre,** the **Blue Fleabane,** favours dry gravelly ground; in Scotland it is very rare. It is a little plant with linear-oblong hairy leaves, and leafy stems a foot or so in height, branched above, and bearing numerous small heads of flowers with a pale yellow disk and pale purple ray. The ligulate corollas of the ray-flowers are short and inconspicuous. The other species, **E. alpinum,** is confined to alpine rocks in the Breadalbane and Clova mountains. It is only a few inches high, with rather large solitary heads of flower, which have a yellow disk and a conspicuous purple ray.

To return to our sea-rocks. The **Beet, Beta maritima,** which straggles among the boulders below us, almost within reach of the waves, cannot be mistaken for any other British plant. The leaves are egg-shaped, tapering at both ends, dark green, fleshy, and so smooth and shining that they look as if they had been varnished. The stems are prostrate, branched, spreading. The small green flowers are borne in long spikes. Each has a five-parted perianth, five yellow stamens, and two or three short styles. When flowering is over, the perianth closes and surrounds the fruit. The Beet belongs to the **Chenopodiaceæ,** the Goosefoot tribe, an Order of plants with more or less fleshy leaves and small greenish flowers. Of the genus *Atriplex* or Orache, some examples occurred in our sea-beach study (p. 89). The only other large genus, **Chenopodium**, is represented in almost every plot of cultivated ground by *C. album*, the White Goose-foot, a very common weed. Most of the other Goose-foots show a preference for manure-heaps, rich ground, and roadsides; they are rather rare, and often uncertain in their appearance. They bear a general resemblance to the Oraches, having lobed egg-shaped or triangular leaves, and panicles and spikes of crowded minute green flowers. The remaining genera of *Chenopodiaceæ*—*Salicornia*, *Suæda*, *Salsola*—are all seaside plants. The last-named we have met with already (p. 89). **Suæda maritima** is common on muddy shores—an inconspicuous annual plant, with crowded, fleshy, finger-shaped pointed leaves often tinged with red, and tiny green flowers. **S. fruticosa**, a rare plant of South-eastern England, can be distinguished by its erect woody perennial stem and leaves with a blunt apex. **Salicornia** is a genus of peculiar appearance. The stem is leafless, succulent, and jointed, each joint swelling upwards and embracing the base of the joint above it. It bears numerous branches, which are given off in pairs at each node, and which again branch. The stiff effect produced by the regular branching reminds us of the formal growth of the *Araucaria* or Monkey-puzzle. *Salicornia* is apparently leafless, and one might think flowerless also, for the tiny flowers are almost buried in the fleshy stem, and present only one or two stamens, and, if we look closer, small green closed perianths, out of which two styles project. **S. herbacea** grows, often in enormous profusion, on mud-flats, covering them with a sheet of vivid green, which changes to brown in late autumn as the plant dies. **S. radicans**, which is confined to the east and south coasts of England, differs in its perennial creeping woody stem and the production of barren branches. Of all salt-marsh plants, *Salicornia* is the one which creeps farthest down towards the sea. *Aster*, *Atriplex portulacoides*, *Suæda*, form a rank fringe of vegetation on the margin of the muddy estuaries, where they are often covered by the tide. But *Salicornia* ventures out on the mud-flats where no other aërial plant can follow it, and where small Sea-weeds grow about it and cling to its stems. There it is often accompanied by another flowering plant that has adopted a marine habitat, the *Zostera* or Grass-wrack. But this species has reached the sea by a different method, for its allies are aquatic species; it has crept down the rivers till now it is as much at home near low-water mark as the Sea-weeds among which it grows. The Grass-wrack and its allies, *Zannichellia* or Horned Pondweed, a genus of brackish-water plants, and *Najas*, a fresh-water group, are particularly interesting as furnishing examples of fertilisation by water. Almost all aquatic plants push their flowers up into the air, and the pollen is carried about by winds or insects. But the species above mentioned liberate their pollen under water, and rely for fertilisation on currents, which carry the elongated pollen-cells about, so that some of them reach the stigmas of neighbouring plants.

Along with the Samphire and Sea Aster and Beet on our cliff grows a species of **Sea-Lavender, Statice auriculæfolia**, and on the rocks close by are several green cushions of a better-known plant of the same Order (**Plumbagineæ**), the **Sea-Pink, Armeria maritima.** The Sea-Lavenders have leathery obovate leaves and wiry leafless flower-stems, which branch repeatedly and bear one-sided spikes of small purple flowers. The Sea-Pinks have linear leaves and tall leafless scapes bearing dense heads of pink flowers. Of the four species of Sea-Lavender, the most distinct one is the rare *Statice reticulata*, found in salt-marshes in a few counties in the east of England. Its leaves are small; the flower-stems fork again and again till they form a maze of tiny branchlets, of which all but the uppermost are sterile; on the uppermost are borne short dense spikes of pale lilac flowers, arranged in two rows. The three remaining species differ chiefly in the form of the inflorescence. **S. Limonium** is the largest British Sea-Lavender. The leaves are broad and often six inches high; they have one central vein, from which others are given off in a pinnate manner; the stem branches in the upper part forming a compact level-topped panicle; each branchlet terminates in a short dense recurved spike of purple flowers. This species grows on the coasts of England and Southern Scotland, but is absent from Ireland. The distribution of **S. rariflora** in Great Britain is similar, but it is also found round the coasts of Ireland. The leaves are much smaller than those of *S.*

Limonium, with a strong central vein and faint secondary ones. The stem branches repeatedly from near the base, and the branches bear long lax spikes of purple flowers; the spikes are either straight or curve upwards. **S. auriculæfolia** haunts rocky rather than muddy shores, such as all the foregoing species frequent. The leaves are

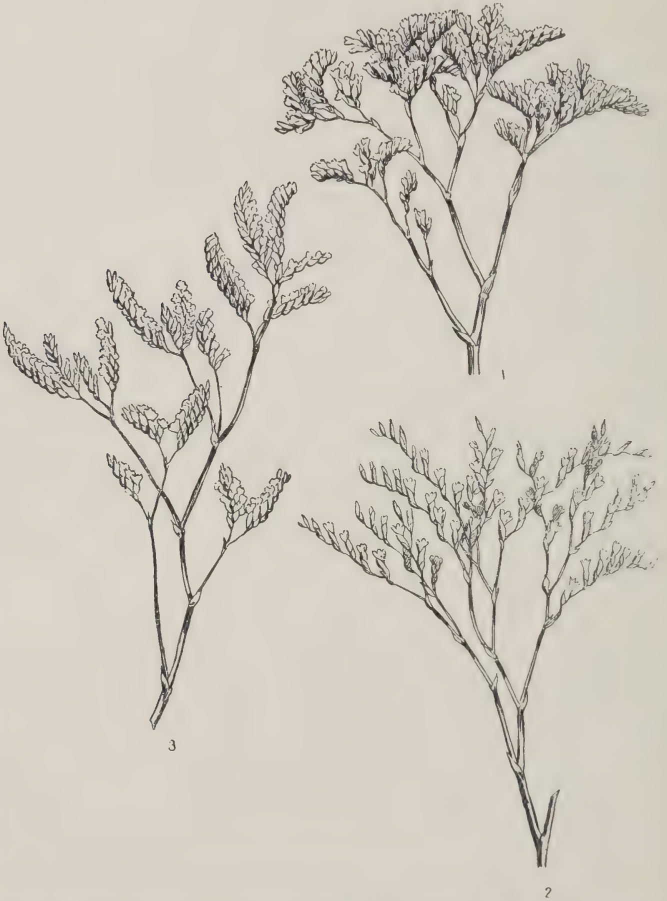


Fig. 38.—Inflorescence of British Sea-Lavenders. Half natural size. 1, *Statice Limonium*; 2, *S. rariflora*; 3, *S. auriculæfolia*.

short; the midrib has a parallel vein on each side of it near the base of the leaf, and no lateral veins in the upper portion. The flower-stems are tall, branched in the upper half, the branches rather short and stiff, and bearing dense spikes of flowers. These three species differ much in appearance, but the differences are not easily put into words, and will be understood better from the sketch of a portion of the inflorescence of each which is subjoined (Fig. 38) than from the above brief description.

Examine *S. auriculæfolia*, which grows here on the sea-cliff. The dense spikes of which the cyme is composed bear two rows of little spikelets, and all the flowers are turned one way. Each spikelet consists of two or three flowers, enclosed by three close bracts. The calyx is five-lobed, green, with the upper part white and chaffy, contrasting prettily with the deep purple bell-shaped corolla. There are five stamens and five long curling white styles.

The **Sea-Pink** it is not necessary to describe. To every frequenter of the sea-shore its green leafy cushions and bright flower-heads are welcome features, and the mountaineer finds it on the high crags among the alpine plants. Note the involucre composed of dry chaffy bracts, and the curious membranous sheath, open below, that invests the upper part of the scape. This species, *A. maritima*, is the only British *Armeria*. *A. plantaginea*, which is included in British lists because it grows in the Channel Islands, is a glabrous larger plant with darker flowers.

So much for the essentially maritime plants of our sea-cliff. Many of the wild-flowers that decorate the steep slope above are also confined to the neighbourhood of the sea, but others have a wider distribution. The beautiful Bloody Crane's-bill, for instance, which is so abundant here, is equally a plant of rocks and dry banks inland. Its cousin, the Hemlock Stork's-bill, *Erodium cicutarium*, which is here also, is chiefly a plant of the sea-board, and its ally, *E. maritimum*, which forms close green patches in the drier places, is very seldom found away from the sea. These three plants belong to the **Geraniaceæ**, a race of herbs with remarkably elegant foliage, and sometimes with striking and handsome flowers. *Geranium* is the principal British genus; many of the species are familiar wayside plants. *Erodium* is closely allied to *Geranium;* and the remaining genera of the Order are *Oxalis*, Wood-Sorrel, and *Impatiens*, Balsam. Of foreign *Geraniaceæ*, the beautiful Geraniums and Pelargoniums of our gardens and greenhouses are the best known; they come chiefly from the Cape of Good Hope, and all belong to the genus *Pelargonium.* The genus **Geranium**, or **Crane's-bill**, is distinguished by its regular corolla, ten stamens, and curious pistil, which consists of five roundish carpels continued into a long style, which is persistent. In fruit each cell of the ovary is attached by its tip to the tip of the beak thus formed, and eventually curls upwards, carrying with it the seed and its cell (see Fig. 39).

Geranium sanguineum, which grows on the steep slope in dark green clusters, with a few late blossoms still lingering, is a well-marked plant (Fig. 39). The size of its beautiful deep crimson flowers, which are often an inch and a half across, and the abundance of dark green deeply-cleft leaves which clothe its short bushy stems, give it an appearance quite unlike that of any other British species. Critically, it is distinguished from the other perennial species by its one-flowered peduncles and smooth carpels. **G. sylvaticum**, **Wood Crane's-bill**, and **G. pratense**, **Meadow Crane's-bill**, are large perennial plants, with deeply-cut leaves and showy purple flowers, borne two on each peduncle. *G. sylvaticum* has *erect* buds and fruit; in *G. pratense* the buds and fruit are *deflexed; G. sylvaticum* has *dotted* seeds; *G. pratense*, seeds *minutely netted.* The plants differ in appearance besides. *G. pratense* is larger, with more numerous, more deeply-cut darker leaves, and larger, bluer flowers. Both are widely spread in England and Scotland, but in Ireland are confined to County Antrim.

Three allied Continental species, **G. striatum**, **G. nodosum**, and **G. phæum**, have established themselves in a few places. The former two have straggling stems and pretty pale pink flowers veined with purple; the latter, which is of more frequent occurrence, may be known by its very dark purple, almost black, flowers. **G. pyrenaicum**, **G. molle**, and **G. rotundifolium** form a group characterised by a perennial fusiform root, but no thickened root-stock, such as all the species already described possess. *G. pyrenaicum* is a straggling plant often a couple of feet high, with reniform seven- to nine-lobed leaves. The purple petals are twice as long as the sepals, their lower portion or claw densely ciliate, and the carpels and seeds are smooth. *G. molle* is a small downy plant with inconspicuous pink flowers, which have short bifid petals with ciliate claws, smooth seeds, and smooth carpels transversely wrinkled. *G. rotundifolium* has small, entire, flesh-coloured petals with glabrous claws; the carpels are covered with spreading hairs and not wrinkled, and the seeds are netted. The two former species are widely distributed, growing in dry places and on roadsides. *G. rotundifolium*

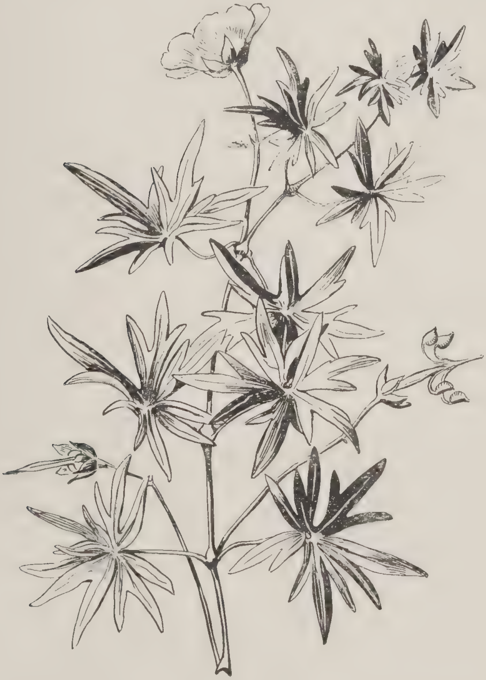


FIG. 39.—BLOODY CRANE'S-BILL, *Geranium sanguineum*.
Half natural size.

is rare, being confined to the southern half of England and one or two stations in Ireland; it haunts old walls and waste places.

The remaining species are annuals. **G. pusillum** has tiny purple flowers with notched petals scarcely longer than the sepals, smooth carpels with adpressed hairs, smooth seeds, and a downy stem. It is widely distributed, but rare in Scotland and Ireland. **G. dissectum, Dove's-foot,** is common in waste land and hedge-banks. The flowers resemble those of the last, but are larger and more deeply coloured. The carpels are smooth, and are covered with erect hairs; the seeds are netted, the stem hairy, the leaves cleft almost to the base, those of the stem on very short petioles, and the flowers are borne on short peduncles. **G. columbinum** is a diffuse plant, with larger flowers and fruit, borne on long peduncles, which much exceed the leaves. The deeply-cut leaves resemble those of *G. dissectum.* The carpels are almost hairless, the seeds are netted. It is widely spread, but rarer in Scotland and Ireland. **G. lucidum**, the **Shining Crane's-bill**, has dark green glossy leaves, which are cleft only half-way down, and tiny rose-coloured flowers with entire petals. The calyx is very broad below and transversely wrinkled, and the carpels are netted and have three keels. This species occurs throughout the British Isles, and is easily known by its smooth and shining stems and leaves, which often turn bright red. Lastly, there is the well-known **Herb-Robert, G. Robertianum,** distinguished by its ternate or quinate triangular leaves and transversely-wrinkled carpels.

Erodium is a smaller genus, with only three British representatives. From *Geranium* it differs in having only five perfect stamens, the remaining five (which in *Geranium* are smaller, but fertile) being reduced to barren filaments. The fruit is similar in shape, but the beak twists spirally as it ripens, instead of simply curving, as in *Geranium.* **E. cicutarium**, the **Hemlock Stork's-bill**, and **E. moschatum**, the **Musk Stork's-bill**, have pinnate leaves and long peduncles bearing clusters of three to ten small pink flowers. *E. moschatum* has egg-shaped leaflets, unequally cut, oval stipules, stamens toothed below, and carpels with a glandular depression. It is a larger plant than the former, and emits a strong smell of Musk when bruised. *E. cicutarium* has pinnatifid leaflets, lanceolate stipules, stamens not toothed, the depressions on the carpels not glandular. **E. maritimum** is easily distinguished from either of the preceding by its simple ovate leaves, which are lobed and cut, and its tiny petals, which are often altogether absent. None of the species of *Erodium* are rare, but *E. moschatum* is absent from Northern England and Scotland, and *E. maritimum* does not extend northward beyond the south of Scotland.

In the Crane's-bills and Stork's-bills, and their allies, some remarkable devices for the dispersion of their seeds are to be found. The carpels of *Geranium* each contain one large seed. When the weak attachment of the lower part of the carpel gives way, and it jerks up into a curved form (see Fig. 39), the seed is thrown out through the rent thus left on the inner face of the carpel. Sir John Lubbock laid fruits of the Herb-Robert on his billiard-table, and found that they threw their seeds in some cases more than twenty feet. In the Stork's-bills, the carpels, instead of being roundish and more or less smooth, are narrow, and furnished with stiff bristly hairs; and, as before remarked, their long beaks, instead of being straight, twist in a spiral manner, the upper end standing out straight at right angles to the axis of the carpel. These spiral beaks are hygroscopic, untwisting in damp weather, twisting in dry. The untwisting causes the straight end to move round like the hands of a clock. If this free end catches among blades of grass, &c., then the thick pointed seed-containing end is forced by the uncoiling into the ground like an augur. The stiff hairs, acting as barbs, prevent the re-twisting in dry weather from dragging the seed out of the soil again. A similar device is to be found in the seeds of the Feather-grass, *Stipa pennata*, a common Continental species, with exceedingly long feathery awns, and in the Wild Oat, *Avena fatua*, a well-known British Grass.

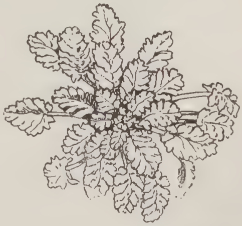


FIG. 40. — SEA STORK'S-BILL, *Erodium maritimum.* Winter leaf-rosette. Half natural size.

The **Wood-Sorrel, Oxalis**, exhibits a sudden rupturing of the fruit and violent expulsion of the seeds, which differs from that of *Geranium*. The fruit is a conical capsule, which opens by a number of valves. The coat of the seeds which it contains ruptures suddenly, owing to the pressure of layers of swollen cells within. The ruptured edges fly back, and propel the seed out through the slit in the capsule in front of them.

The remaining genus of *Geraniaceæ*, **Impatiens** or **Touch-me-not**, possesses explosive capsules that have long been noticed. **I. Noli-tangere**, the **Yellow Balsam**, is a striking plant, with a thick succulent stem, delicate green foliage, and large and handsome yellow flowers, which hang horizontally on slender peduncles. The flowers are irregular, with a great yellow lip like a Bladderwort, and one of the sepals is transformed into a large hooked, conical, yellow spur. The fruit is an oblong capsule composed of five carpels. As the seeds ripen a layer of cells in the outer wall of the carpels becomes so turgescent that it bursts the capsule violently open, sending the seeds flying in all directions, the carpels remaining connected by their tips only, like those of the Crane's-bills. The Latin and English specific names are derived from the readiness with which the ripe capsule explodes on the slightest disturbance.

It may not be out of place to refer here to one or two other types of "**sling-fruits**" which may be found among British plants. The common **Dog Violet, Viola sylvatica,** furnishes a pretty example. The three-sided oblong capsule opens widely, as the fruit ripens, into three boat-shaped segments, each filled with a double row of seeds. When the fruit is quite ripe, the two sides of each "boat" are pulled towards each other by the unequal contraction of certain cells, and, as a result of the pressure thus induced, the seeds are shot out one by one. Another familiar instance is furnished by the pods of the Cresses, *Cardamine*, such as the Hairy Cress, *C. hirsuta*, and other common species. The pods split open suddenly and the valves roll up backwards, flinging out the seeds. Other examples will be discovered among our English wild-flowers by the observant student.

An interesting little plant grows on a dry bank on the steep slope—the **Hare's-foot Trefoil, Trifolium arvense.**

Among the many British species of *Trifolium* this one is conspicuous on account of its soft cylindrical heads, which appear clothed with grey fur. For the rest, the plant is an annual, branched, wiry, downy. The flower-heads are its striking peculiarity. Examine one of them. It will be found that it is the calyx that is responsible for the unusual appearance of the plant. Its five long, narrow, hairy segments project far beyond the small pink corolla, and form the soft grey or pinkish fur; they are persistent, remaining till the fruit falls. This pretty plant is of frequent occurrence on dry banks and fields. Another Trefoil with a curious calyx is **T. fragiferum**, the **Strawberry-headed Clover** (Fig. 42), a plant of damp meadows, especially near the sea. In its habit of growth and foliage it closely resembles the common White or **Dutch Clover, T. repens**, and, except that the blossoms are slightly smaller

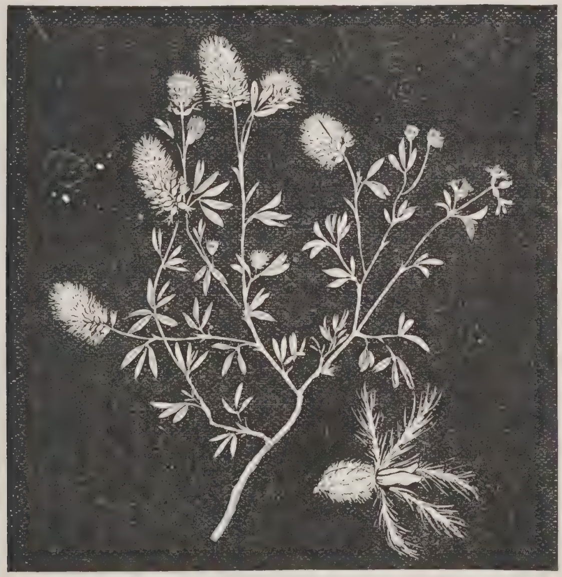


FIG. 41.—HARE'S-FOOT TREFOIL, *Trifolium arvense.*

1. Half natural size. 2. Single fruit, × 4.

and pinker, the flower-heads also might easily be passed over as those of the former species. But as soon as flowering is over, the upper portion of each calyx grows rapidly, and swells out into a veined semi-transparent pinkish bladder, so that the small flattish flower-head develops into a globular head three-quarters of an inch across, formed of the swollen calyxes, each surrounding a small fruit-pod. The drawing shows the plant, and one of the fruit-calyxes enlarged. When in flower, the best character by which this species may be distinguished from the Dutch Clover, which is common in similar situations, lies in the bracts at the base of the head, which in *T. fragiferum* alone form a distinct involucre. *T. repens*, on the other hand, may be mistaken for **T. hybridum**, an introduced Clover often run wild; but the latter species has erect stems, whereas *T. repens* and *T. fragiferum*, alone among British Trefoils, have stems which creep and root at intervals. *T. hybridum* has, besides, globular depressed heads of pinkish flowers, while the heads of *T. repens* are white and erect.

Twenty-three species of Trefoil are listed in the "London Catalogue of British Plants," five of which are not reckoned as natives. In addition to the species mentioned above, the following are those of most frequent occurrence. **T. pratense**, the familiar **Red Clover** of our pastures, does not need description. **T. medium**, the **Zigzag Clover**, may, however, easily be confounded with it, and the points of difference between the two must be noted. *T. medium* is in general a smaller, more compact plant, with narrower, darker, unspotted leaflets and deeper red flowers, and a zigzag stem, and it grows on dry banks and hilly places: it has shortly-*stalked* heads and *herbaceous* stipules with *spreading lanceolate* lobes, while *T. pratense* has *sessile* heads, and *membranous* stipules with the free portion *blunt* and *ovate* and *adpressed* to the petiole. These two species are sometimes sufficiently hard to distinguish. **T. subterraneum** is a tiny plant with heads of three or four slender white blossoms. The greater part of the flowers are abortive, and appear as stiff fibres which split into five —these are the modified calyxes. They fold back over the fruit when ripe; the peduncle then bends downwards, and forces the fruit into the ground—a remarkable case of self-sowing. This species is confined to the southern half of England. **T. squamosum** (= *maritimum*) is another Southern English species, found in salt marshes and meadows. It is a branched plant, with roundish heads of small pink flowers. The calyxes grow after flowering, and the five broad teeth spread like a star, forming conspicuous green heads. **T. striatum** and **T. scabrum** are somewhat like each other, both being small annuals with numerous egg-shaped sessile heads of inconspicuous flowers. In the fruit, however, they differ, that of *T. striatum* being enclosed in the ventricose calyx-tube, with narrow spiny calyx-teeth, while in *T. scabrum* the calyx-tube is cylindrical, and the teeth triangular and wide-spreading. The flowers of *T. striatum*, moreover, are rose-red, those of *T. scabrum* white and minute. Both species are found in dry pastures throughout England, becoming rarer in Scotland and Ireland. Three yellow-flowered species of wide distribution, *T. procumbens*, *T. dubium*, and *T. filiforme*, we shall meet with in a future chapter (p. 201). For descriptions of the remaining British species, all of which are rare, a book of wider scope must be consulted.

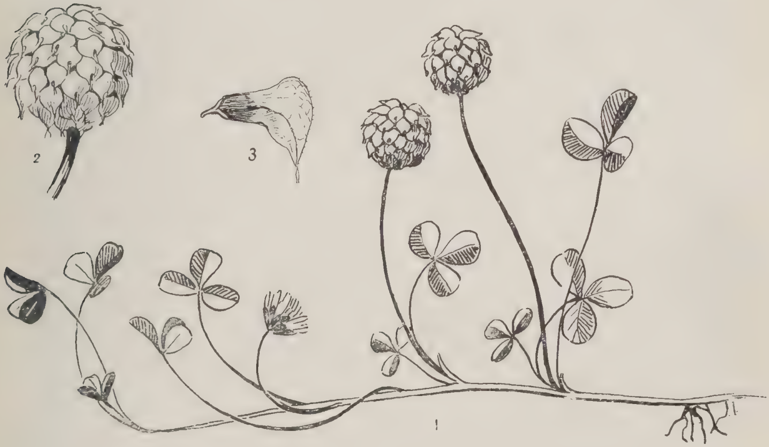


FIG. 42.—STRAWBERRY-HEADED CLOVER, *Trifolium fragiferum*.

1. Half natural size. 2. Head of fruit, natural size. 3. Single fruit, × 2.

In bushy spots on the steep slope, where stunted

Brambles cling, the dark-green foliage of the **Wild Madder, Rubia peregrina,** peeps out from the rank grass. This is the only British species of the genus, and is easy of recognition. The stems are tough, with four angles furnished with hooked bristles; the ovate leaves, which grow in whorls of four or more, are likewise armed with backward-curved prickles on the edges and the under side of the midrib, so that the plant clings to everything it comes in contact with. The flowers are small and greenish-white, disposed in cymes. There is no calyx-limb; the corolla has five tapering lobes. The stamens are five; the fruit consists of two globular fleshy carpels, adhering by one face. In the succulent fruit and non-separation of the ripe carpels, *Rubia* differs from the large allied genus **Galium** or **Bedstraw,** the two dry carpels of which separate when ripe. Thirteen species of *Galium* are included in the British list. Many of these are plants of common occurrence. **G. boreale** is a native of rocky ground; it is well distinguished by its three-veined leaves in whorls of four, and its white terminal panicles of flower. **G. Cruciata,** the **Crosswort,** is a common hedgerow plant in England and Scotland, though very rare in Ireland; in its soft, hairy, broad, sessile leaves, four in a whorl, and short, axillary cymes of yellow flowers, it differs from all the other native species. The only other yellow-flowered species is **G. verum,** which has whorls of linear leaves, and panicles of fragrant honey-scented flowers, which the bees love; it is one of the most welcome of summer wild-flowers, and abounds on dry banks and wastes. **G. Aparine, G. tricorne, G. Vaillantii,** and **G. anglicum** form a group of annual species with flowers in axillary cymes only. *G. Aparine,* the well-known Goose-grass or Cleavers, will serve as a type for all —a scrambling plant with linear-lanceolate leaves in whorls of six to eight, inconspicuous white flowers, and stem and leaves copiously armed with reflexed bristles, by means of which they cling to everything they touch. The special characters of *G. Aparine* are its clusters of about three small white flowers, and its rather large fruit, covered with hooked bristles. *G. Vaillantii,* often considered a variety of the last, differs in its three- to nine-flowered clusters of small green flowers. It grows only at Saffron Waldon in Essex. *G. tricorne* has deflexed bristles on leaves and stems, and small white flowers in few-flowered cymes, like *G. Aparine*, but differs in the fruit, which is deflexed, destitute of hooks, and has a granular surface. It grows in most parts of England, but not in Scotland or Ireland. *G. anglicum* can be distinguished by the prickles on the margins of its leaves pointing *forwards*, and its minute granular fruit. It is a small species found in dry places in South-eastern England.

There is left a group of six perennial species with terminal panicles of white flowers. Of these, **G. palustre, G. uliginosum,** and **G. saxatile** are abundantly distributed throughout our islands, with the exception that the second is rare in Ireland. *G. palustre* is a tall straggling plant of marshes and ditches. It has blunt leaves, four in a whorl (in all the others of this group the leaves are in whorls of six to eight), stems rough with downward-pointing prickles, large spreading panicles, and smooth fruit. *G. uliginosum*, which grows in similar situations, is known from the last by its six- or eight-whorled leaves, small few-flowered panicle-branches, and granular fruit. *G. saxatile* is a well-marked and pretty little species, growing in close mats on heaths and dry banks. The leaves are in whorls of six, narrowly-obovate, with a terminal point. The flowers are borne in small panicles, but are often conspicuous on account of their abundance; the fruit is rough with tubercles. **G. Mollugo** is a large species (often two feet high), with narrowly-obovate leaves in whorls of eight, large panicles with the branches spreading horizontally, and white petals with slender tips. It has a wide distribution, growing in hedges and thickets. **G. erectum** is difficult to distinguish from the last. It is a smaller, less-branched plant, with the branches of the stem and panicle erect, and more erect lanceolate leaves. **G. sylvestre,** the last species, is of rather rare occurrence, though it ranges throughout the British Isles, growing in dry places. In both appearance and habitat it comes nearest *G. saxatile,* but it does not grow in close mats, the leaves are narrower, the panicle-branches longer and more erect, the fruit smaller and less rough. The plants of this last group will be found somewhat difficult to distinguish, the more so because varieties exist which connect one with another.

The other genera belonging to the Order *Rubiaceæ* are *Asperula* and *Sherardia.* **Asperula odorata** is the **Woodruff**, which, when dried, smells so fragrantly of new-mown hay. *Asperula* differs from *Galium* in its *bell-shaped* (not flat) corolla; from *Rubia* in its *dry* (not fleshy) fruit. The Woodruff sends up from a slender perennial root-stock erect unbranched stems, bearing whorls of about eight smooth long-elliptic leaves, and small terminal clusters of white flowers, borne on several peduncles which spring from the uppermost leaf-whorl. The fruit consists of a pair of globular carpels, as in *Galium*, which in this species are covered with soft hooked bristles, white with a black tip. The only other British species is **A. cynanchica**, the **Squinancy-wort**, a little tufted plant with linear leaves four in a whorl, corymbs of pretty pink flowers, and wrinkled tubercled fruit devoid of hairs. It is found in dry ground in England, and South and West Ireland.

Of *Sherardia*, **S. arvensis**, the **Field-Madder,** is the only British species, a prostrate *Galium*-like plant with whorled lanceolate leaves and small lilac flowers, borne in terminal involucrate heads. This is a common plant in fields and waste places, and easily distinguished by its inflorescence.

The **Rubiaceæ** are a very large Order of plants, numbering some 4500 species. All the British species, as briefly reviewed above, are herbaceous, with leaves in whorls, and belong to the group *Galieæ*. These whorls are in reality composed of a certain number of leaves, and an equal number of "pseudo-leaves" alternating with them; the latter are formed by the fusion of pairs of stipules, the stipule on the right side of one leaf-base uniting with that on the left side of the adjoining leaf. In shape, texture, and function they are identical with the true leaves, and their real nature is only seen by noting the position of the axillary buds in each whorl.

Before leaving our flower-decked sea-slope, one other plant may be examined and taken as a text for a brief description of the genus to which it belongs. This is the **Small Upright St. John's-wort, Hypericum pulchrum.** *Hypericum* is the only British genus of **Hypericineæ**, an Order of which the St. John's-worts are typical examples. The species which grow in our Islands are eleven in number, not taking into account several Continental forms which have run wild. The St. John's-worts are readily known by their entire egg-shaped sessile leaves in opposite pairs, and terminal panicles of yellow flowers with five petals, and abundant long stamens arranged in three or five bundles.

H. Androsæmum, the **Tutsan**, may be found in woods and on shady banks. Its large egg-shaped leaves, two to three inches long, large unequal oval sepals, three very short styles, and stamens arranged in five bundles, will distinguish it both from other British species and from several allied introduced kinds. Of the latter, the most familiar is **H. calycinum**, a favourite plant of shrubberies, with a far-creeping rhizome and grand yellow flowers three to four inches across, with a great bundle of red-tipped stamens opposite each petal. The foregoing plants have the stamens arranged in *five* bundles; in all the rest *three* bundles only are found. **H. perforatum**, the **Dotted-leaved St. John's-wort**, is a handsome species commonly met with in bushy places and dry wastes. The erect stem is two-edged; the leaves have numerous pellucid dots (seen when the leaf is held against the light), the sepals are erect, narrow, acute. **H. dubium** is like the last and grows in similar situations; the stem is quadrangular, the leaves have many pellucid veins but no pellucid dots, the sepals are reflexed, ovate, blunt. **H. quadratum** is common in wet places and by the sides of ditches. Its stem has four distinct wings, the leaves have pellucid dots and veins, the sepals are erect and lanceolate. The flowers differ considerably from those of the two preceding, being much smaller and pale yellow, and arranged in close cymes; the styles are much shorter, being only about half as long as the capsule. **H. undulatum** is found only in Cornwall and Devon. It is a slender lax plant, two or three feet high, with leaves wavy at the edge, and having many pellucid dots and veins, and bright yellow flowers which in bud are tinged red on one side. **H. humifusum**, the **Trailing St. John's-wort**, is the smallest British species—a little much-branched prostrate plant, with stems only a few inches long. Its habit and small size will alone distinguish it; it is of frequent occurrence in dry fields and heathy places. **H. linarifolium** is found only in Cornwall, Devon, and Carnarvon. It has short (six to twelve inches) upright round stems, and broadly-linear blunt leaves with revolute margins. **H. pulchrum**, which grows among the tangle of vegetation on our sea-slope, is a graceful little plant, with wiry erect stems and bright yellow flowers tipped with red on the outside. The leaves are glabrous, and their broad cordate bases clasp the stem. It haunts heaths and banks all over the British Isles. **H. hirsutum** differs from all the other species in its hairy stem and downy leaves; the flowers are pale yellow. This species is widely spread in woods and thickets. **H. montanum** is almost confined to England, where it is found in dry copses. It is nearly glabrous, with erect round stems, and sepals fringed with shortly-stalked glands. The flowers are crowded together in a dense panicle. The last British species is **H. elodes**, the **Marsh St. John's-wort**, which we have already met with in the bogs of Connemara (p. 122). It is very different from any other species, on account of the stamens of each of the three sets being united in their lower half, with a little scale between each set.

But enough of botanical jargon. From the little yellow stars of the St. John's-wort our eyes wander away along the rocky slope, now deep in shadow. The breeze has dropped away, but the waves still spout up unceasingly. A few late bees hum past us, and an Oyster-catcher flashes along below, with black and white plumage and bright red beak and legs. As he sees us he gives a wild cry of warning and wheels out into the sunlight, and a great lazy Cormorant, resting after his day's fishing, startles from the rocks and flaps heavily over the water. Across the bay the high granite hills of Dublin, and the quartzite cone of the Sugar-loaf in Wicklow, are lit up by the yellow light of the setting sun, which glints back from the windows of Kingstown, and shines on the long low walls of the harbour. As we watch, the big Holyhead mail-boat emerges from between the pier-heads in a cloud of dark smoke, and we lie and watch it spreading eastward and fading into a dim grey cloud-bank, till only a black bar of smoke, straight as the horizon itself, remains to mark its course.

PURPLE LOOSESTRIFE AND MEADOW-SWEET.

A CAVAN MEADOW, *July* 1896.

PLATE VI.]

SCENE VIII

A FLOWERY MEADOW

(Near Lough Oughter, Co. Cavan, *June* 1896.)
[Plate VI.]

> "And what is so rare as a day in June?
> Then, if ever, come perfect days;
> Then Heaven tries the earth if it be in tune,
> And over it softly her warm ear lays.
> Whether we look, or whether we listen,
> We hear life murmur, or see it glisten.
>
> . . . . . .
>
> The cowslip startles in meadows green,
> The buttercup catches the sun in its chalice,
> There's never a leaf or a blade too mean
> To be some happy creature's palace."
> —Lowell: *Vision of Sir Launfal.*

Here we are waist-deep in flowers! It is a little patch of damp, peaty meadow-land, shut in by natural copses of Willow and Birch, watered by the drainage of the neighbouring bog, sheltered by the tall, dark pine-wood that rises behind. To the left are rich damp meadows—

> ". . . Meadows where in sun the cattle graze;
> Where, as the breezes pass,
> The gleaming rushes lean a thousand ways."—Lowell.

What a blaze of colour! The long spikes of the Purple Loosestrife give a rich rose-red tint to the whole scene; and everywhere these are set off by the creamy, cloudy flower-masses of the Meadow-sweet. There is a patch of great Ox-eye Daisies, pure white with a bright yellow centre; there rises, five feet high, a miniature forest of Field-Thistles, with greyish foliage and pink flower-heads; there again a stately Marsh Plume-Thistle, erect and taller than our heads, with dark spiny leaves and purple flowers. Elsewhere are groves of Willow-herb, with downy foliage and pink blossoms, and tall yellow Sow-Thistles, and grand Angelicas, with pale pink umbels nearly a foot across.

The hot afternoon air is laden with the rich fragrance of the Meadow-sweet and with the droning of a myriad of bees. White and brown butterflies flutter from blossom to blossom; a gay Tortoise-shell sails across in rapid restless flight; and Dragon-flies, blue, and red, and brown, flash here and there, and rattle their wings among the grasses. Beetles fly heavily from place to place, and crawl with closed elytra over the flowers; and flies and gnats of half a hundred kinds flicker and dance in the sunlight. Over them the Swallows swoop and twitter; in the bushes finches and warblers rustle and chirp; and the peaceful cooing of the Wood-quests comes softly from the pine-trees. It is high summer, and all the country has donned its richest garb.

The vegetation of this sheltered corner has a character of its own. Tall leafy-stemmed plants have apparently crowded out everything else. There are no small or creeping plants here; they would be smothered among their taller brethren. Everywhere rise stout upright stems, and the blossoms spread in a level plain at a height of three or four feet above the ground. Certain annual plants which appear among the thick growth point to cultivation of this spot at no very distant date; the Sow-Thistles, for instance, like more open ground, and will probably not long survive in the crowding which is going on here. Their neighbour, the Marsh Plume-Thistle, is a stronger plant, which holds its own even in the dense vegetation of a pasture, crushing the other plants out with its close rosette of spiny prostrate leaves, and shooting up, armed against all enemies, far above its neighbours. These Sow-Thistles are handsome plants. They are not genuine *Thistles* at all, for that term is properly applied to Composite plants with the flowers all tubular—the division *Cynarocephaleæ* of the great Order *Compositæ*—whereas these belong to the Dandelion group or **Ligulifloræ.** The foliage of the Sow-Thistles is glabrous and succulent, and the plants abound in white acrid milky juice, like so many of their allies. The four British species of **Sonchus** or **Sow-Thistle** are easily distinguished. Two of them, **S. asper** and **S. oleraceus**, are common annual weeds, and are somewhat alike. Both have stout hollow leafy stems, branched above. The stems are hollow tubes, strengthened by transverse partitions at intervals—a form of stem combining in an eminent degree the qualities of strength and economy of material. The leaves are boldly lobed and cut, with spiny edges and clasping bases. The heads of flowers are numerous, small for the size of the plant, yellow, borne in branched umbel-like clusters. These two species are distinguished by their fruit, which is oblong, ribbed, and crowned with a short sessile pappus; in *S. oleraceus* it is transversely wrinkled; in *S. asper* the transverse wrinkles are absent. Although the leaves vary in shape in both species, being sometimes pinnatifid, sometimes nearly entire, the two can be separated by the shape of the base of the stem-leaves. In *S. oleraceus* they are prolonged into two tapering straight lobes. In *S. asper* the lobes clasp the stem and curve downwards and then backwards, giving the leaves a striking spurred appearance. Of the remaining two species, **S. arvensis** is a common weed in cornfields. It has a perennial creeping, fleshy root-stock, from which rise tall, leafy, unbranched stems crowned with a spreading panicle of very large and handsome yellow flower-heads. The leaves are long, narrow, and lobed, the peduncles and involucres densely clothed with long hairs tipped with glands (in *S. oleraceus* and *S. asper* these parts are without hairs). Lastly, there is **S. palustris**, an extremely rare plant of the marshes, now on the verge of extinction, owing to drainage. In general appearance it resembles *S. arvensis*, but differs in its narrower leaves, the absence of underground shoots, and other particulars.

It will be remembered that in a former chapter (p. 77) this Dandelion group of *Compositæ* was referred to, and one section of them dealt with briefly. We may now take up the remaining section—those with leafy stems—and mention at least the commoner species which come under this head. The **Nipple-wort, Lapsana communis**, a common roadside annual, is easily recognised by its lower leaves, consisting of one large broad terminal lobe and a few small lateral ones, its much-branched stem bearing numbers of very small heads of flower, and its fruit, which is destitute of a pappus, or crown of feathery hairs. The **Succory** or **Chicory, Cichorium Intybus,** with its branched, almost leafless stems and beautiful large heads of light-blue flowers, can be mistaken for no other British species; it is one of the few plants of this group that has not yellow blossoms. The **Goat's-beards, Tragopogon**, are distinguished by their erect growth and undivided grassy leaves, the radical ones linear, the upper broadly clasping the stem. **T. pratense**, a common plant in pastures, has yellow flowers, and leaves very broad at the base. **T. porrifolium**, which is not a native, but is established in various places, has purple flowers, leaves only slightly broadened below, and the peduncle much thickened below the flower. **Picris (Ox-tongue)** has two British representatives, rough plants covered with hooked bristles. **P. hieracioides**, named from its resemblance to certain Hawkweeds (*Hieracium*), has narrow, toothed, rough leaves, and a tall rough stem bearing numerous heads of yellow flowers. There is one ring of large equal, erect phyllaries, with smaller spreading unequal ones at their base. The fruit is shaped like a cucumber, with a constriction just below the feathery sessile pappus. In the British Isles it is practically confined to England, only just crossing the Scottish border. **P. echioides** is more easily known on account of its curious and striking involucre, which consists of five very broad heart-shaped phyllaries enclosing a ring of narrower inner ones. It is a rough plant, with spreading branches, rather broad entire leaves with spiny margins, and heads of yellow flowers; it is everywhere covered with strong hooked bristles, which arise from white tubercles. It has almost the same distribution as the last, but occurs also in Eastern Ireland. The genus **Lactuca** or **Lettuce** is represented by five species. This genus has few-flowered heads surrounded by an irregular aggregation of phyllaries, and fruit with smooth ribs. **L. muralis** is a slender glabrous plant, one to two feet high, with remark-

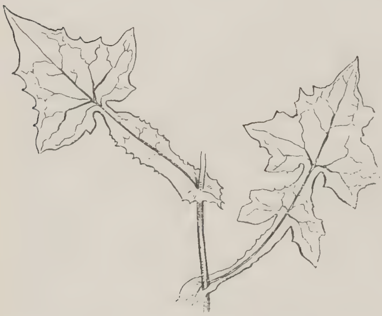


FIG. 43.—LEAVES OF IVY-LEAVED LETTUCE, *Lactuca muralis*. One-third natural size.

ably pretty angular-lobed leaves with clasping bases (Fig. 43), and a large panicle with widely-diverging branches bearing numerous small yellow flower-heads; the stalk of the pappus is much shorter than the fruit. It grows on walls and waste places. **L. virosa** is a tall coarse plant, with oblong uncut spreading leaves with toothed margins, clasping at the base, and a long branched panicle of yellow flowers. The beak or pappus-stalk is as long as the fruit. It grows in dry places like the last. **L. Scariola** is a rare plant, known by its thistle-like leaves, the upper ones standing vertical. **L. saligna** is also rare, and generally grows near the sea. Its upper leaves are entire and very narrow, sagittate at the base, tapering to a point, and the beak is twice as long as the fruit. The panicle-branches are so short that the flower-heads appear nearly sessile. The last, **L. alpina**, sometimes placed in a separate genus, **Mulgedium**, is a rare Scotch alpine plant, and is very different from the other species, as it bears many-flowered heads of pale blue flowers in a simple hairy raceme. The leaves are pinnatifid, with a large terminal lobe. There is no beak, the pappus springing from the top of the fruit.

The next genus, **Crepis (Hawk's-beard)**, will be found rather difficult by the beginner. Eight species are listed in the "London Catalogue," two of which, *C. setosa* and *C. nicæensis*, are certainly introductions. They are in general hairy annual or biennial plants, growing in meadows and waste places, with leaves divided like those of the Dandelion, and numerous heads of yellow flowers. Two are common. **C. virens** is an abundant plant in fields and on dry ground, and is very variable, growing sometimes several feet high and much branched in rich soil, or only a few inches high with spreading radical flower-stems on rabbit-cropped sand-dunes. Its upper leaves are linear and sagittate, the uppermost being reduced to tiny linear bracts; the lower are variously cut and lobed. The stem is much branched, the branches slender. The leaves are glabrous; the flower-heads small. The inner row of phyllaries is as long as the pappus. **C. paludosa**, the only other species which can be designated common, is well distinguished by its thin, glabrous, uncut leaves. The lower ones are broad, tapered at both ends, on slender stalks; the upper sessile with a narrow clasping base. The stems are slender and slightly branched. The fruit is not narrowed at the top.

Lastly, there is a puzzling group of **Hawk-weeds, (Hieracium)**, which all agree in having stems unbranched below, which bear more or less numerous leaves, and divide above into a panicle of yellow flower-heads. The Hawk-weeds are distinguished from allied genera by their numerous overlapping oblong phyllaries, and their abruptly truncate ribbed fruit, which is *round* in section, and bears a brittle sessile brown pappus. They are one of the most puzzling genera among British plants, and while some authorities would group the British forms under about ten species, others raise the number of species to over one hundred. They are chiefly plants of the mountains, but a few species are not uncommon on hedge-banks, walls, and waste ground.

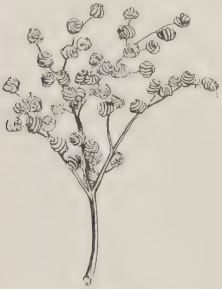


FIG. 44.
FRUIT OF MEADOW-SWEET,
Spiræa Ulmaria.
Half natural size.

The **Meadow-sweet, Spiræa Ulmaria**, which perfumes the whole air around us, is an old favourite and well known to us all. But several points about it are worth noting. Observe the pinnate leaves, with one or two pairs of tiny intermediate leaflets between each pair of the larger ones; both sets are egg-shaped and pointed, with toothed margins; the terminal lobe is large and three- or five-lobed. The creamy flowers have many conspicuous stamens, and a group of carpels each inclining to the left, so that they have a twisted appearance. This becomes much more marked in fruit, when the carpels form a compact spiral cluster (Fig. 44). *Spiræa* is a large genus of beautiful plants, some herbs, some shrubs; they are inhabitants of the colder portions of the northern hemisphere, and are much cultivated in our gardens. Only one other species inhabits Britain. **S. Filipendula**, the **Dropwort**, grows in pastures from Caithness to Cornwall, but is very rare in Ireland. It is in general appearance like the Meadow-sweet, but its leaflets are smaller, narrower, and much more cut, its flowers larger and fewer, its carpels not twisted together, and the roots bear curious large knobs. **S. salicifolia** is sometimes found, apparently wild, in bushy places. It is a shrub with numerous oblong serrate leaves and dense clusters of pink flowers. The stem creeps, sending up tall leafy shoots.

Spiræa belongs to that large Order, the **Rosaceæ**, particularly important to us as embracing plants which produce a number of our favourite fruits. Apples and pears, plums and cherries, peaches, apricots, strawberries, blackberries, quinces, almonds, are all borne by species belonging to this Order. No doubt the advantage to the plant of these attractive and juicy fruits is that they induce animals to assist in the dispersal of the seeds by using them as food, and it is interesting to note how different portions of the flower in different species develop into the sweet pulpy tissue that is so grateful to both ourselves and other fruit-eaters. In the genus *Prunus*, which yields us plums, damsons, cherries, &c., the one-celled ovary is enclosed in a hard woody coat, which is in its turn covered by a fleshy envelope, which becomes soft, sweet, and coloured as the seed ripens—just at the time when it is ready for dispersal and no sooner. The ripe sweet pulp is protected against the ravages of many small insects, &c., which could be of no service in scattering the seed, by a tough bitter skin. The calyx surrounds the ovary in flower, but falls off as the fruit matures. Here it is the outer layers of the seed-vessel or pericarp that becomes fleshy and sweet, while the inner layers become hard and woody, and form the stone of the fruit. In apples and pears (the genus *Pyrus*) the ovary is five-celled. The calyx-tube adheres to the ovary, and as the seed ripens swells out and becomes the juicy fruit we know so well; the five lobes which formed the upper part of the calyx may still be seen when the fruit is ripe as a little dark crown at its top. In the Strawberry, *Fragaria*, a large number of separate carpels are borne on a common receptacle, as in the Buttercup; the receptacle enlarges in fruit and becomes red and sweet, forming the delicious fruit we so highly prize. The Blackberry and Raspberry (*Rubus*), which belong to the same group of *Rosaceæ* as the Strawberry, are, when in flower, very like the latter. The receptacle, however, does not swell, but the coat of each carpel becomes pulpy and sweet, and turns black or red, as the case may be. It should be noted how much man has (looked at from his own point of view) improved most of these fruits by cultivation. Unassisted nature has produced sloes and bullaces, wild strawberries, crab-apples, and wild pears—fruits which by their smaller bulk and greater acidity are no doubt best adapted both for protecting the young seed and dispersing it by natural means when it is mature. By long-continued cultivation and selection of those plants which bore the largest and sweetest fruit, gardeners have produced from this material the luscious and comparatively enormous fruits of our gardens and orchards.

The *Rosaceæ* include plants apparently very dissimilar. Various members of the Order will turn up in our rambles, but it may be useful to mention here the different groups into which it is divided. The **Amygdaleæ** or Almond group is distinguished by its fruit, which is a *drupe*—that is, a single seed enclosed in a hard case, which is in turn enclosed in a fleshy envelope. The plum and cherry are examples, and *Prunus* is the only British genus belonging to this division. The **Roseæ**, or Rose group, contains the majority of British *Rosaceæ.* The plants belonging to this group have several separate carpels, distinct from each other and from the calyx-tube. It is divided into several sub-groups or tribes. The Meadow-sweet, as we have seen, has a fruit of several carpels free from the calyx-tube; the next sub-group comprises several genera, Burnet (*Sanguisorba* and *Poterium*), Agrimony (*Agrimonia*), and Lady's-mantle (*Alchemilla*), in which the carpels are enclosed in the dry calyx-tube. The large sub-group **Dryadeæ** has a fruit consisting of a number of small dry nuts inserted on a receptacle free from the calyx-tube. Here belong the large genus *Potentilla*, the Strawberry, the complicated genus *Rubus* or Blackberry (which is exceptional in having each seed enclosed in a pulpy envelope), the pretty *Dryas* or Mountain-Avens, whose fruits have a long feathery tail, and the Avens or *Geum;* the genus *Rosa* differs from these in that its many dry fruits are enclosed in the fleshy calyx-tube. Lastly, the Apple group or **Pomeæ** is distinguished by its thick fleshy calyx-tube, which adheres to the carpels; here belong the

Hawthorn (*Cratægus*), the rare *Cotoneaster*, the Medlar (*Mespilus*), and the genus *Pyrus*, which includes the Wild Apple, Wild Pear, Service-tree, and Beam-tree. The points of resemblance, by which all these plants are brought together into one Order, are the regular flowers, the many stamens inserted on the calyx-tube, and the ovary of one or more free or connate (joined together by their sides into a ring) carpels. The *Rosaceæ* is a large Order, including about a thousand plants of all sizes, from tiny herbs to tall trees, and found in every part of the globe.

The most striking denizens of our meadow, besides the Marsh Plume-Thistles, are two Umbelliferous plants—the

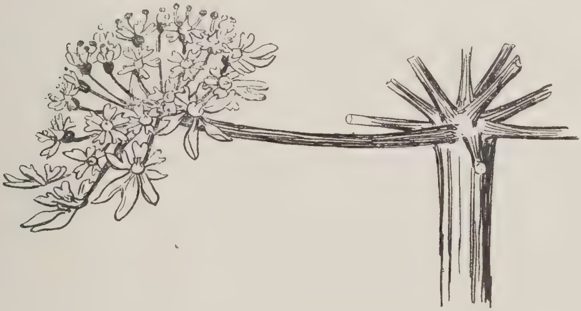


FIG. 45.—COW-PARSNEP, *Heracleum Sphondylium.*
Inflorescence with all the rays of the compound umbel but one cut away.
Two-thirds natural size.

Wild Angelica, Angelica sylvestris, and the **Cow-Parsnep, Heracleum Sphondylium.** These are common plants. The former loves damp meadows. It is distinguished by its stout smooth stems, several feet high; its very compound leaves, the ultimate segments of which are ovate and pointed, one to two inches long, with a sharply-serrate margin; the enormously-expanded petioles of its stem-leaves, and its large umbels of pinkish-white flowers. The Cow-Parsnep or Hogweed is too well known as a troublesome weed to need description, but it is a handsome plant when growing luxuriantly, as it is doing here. The tall stem is rough and furrowed, the boldly-cut leaves are hairy, the large umbels creamy white. In both of these species we may observe a character which is frequent in

Umbelliferous plants, and in some others which bear their flowers in flat crowded masses. While the corollas of the flowers in the centre are small and regular, those of the exterior flowers are irregular, the outermost corolla-lobes being much larger than any of the others. In fact, where there was room for the corollas to increase in size they have increased. The accompanying sketch (Fig. 45) of a single umbellule of *Heracleum* shows this feature. In the Guelder-Rose, *Viburnum Opulus*, the outer flowers of the umbel-like clusters have large white corollas—on which, indeed, they appear to have expended all their energy, for they have neither stamens nor pistils—while the centre of the clusters is occupied by perfect flowers with small corollas. Some species of Scabious, such as *Scabiosa arvensis*, show the same character, the outer corolla-lobes of the outermost flowers being much enlarged. In certain *Compositæ* of the Thistle group (*Cynarocephaleæ*) the outermost florets are much larger than the rest; for instance, in the Blue-bottle, *Centaurea Cyanus*, and Greater Knapweed, *C. Scabiosa*. The ligulate flowers of the Daisy group, which have heads with a compact "eye" of small regular flowers, and a marginal fringe of flowers with a long corolla-limb pointing outwards, appear to be an extreme case of the same nature. Probably the object of these enlarged corollas—"flags," as Lubbock calls them—is in all cases the same—to attract insects to the plants; and they are placed where they will not interfere with the functions of the neighbouring flowers.

The **Purple Loosestrife, Lythrum Salicaria**, fills the foreground with a forest of long spikes of rose-coloured flowers. The unbranched four-angled stem bears numerous whorls of sessile, tapering, entire leaves, generally in threes, and from the axils of the upper leaves spring the whorls of flowers. These are not true whorls—that is, the flowers do not spring from a number of points at the same height on the stem, but are borne in two shortly-stalked heads which arise from the leaf-axils. Note the curiously-wavy petals, which look as if they had been crumpled up and then smoothed out. If we examine the stamens and styles of a number of flowers, a strange diversity of form becomes apparent. There are twelve stamens and a single style. Six of the stamens are of one length, six of another, and the style of a third length. But the lengths of the three sets are interchanged in different flowers. In one flower the style will be shorter than either set of stamens. In another, six stamens will have taken the place of the style, and the style will be of length intermediate between that of the two sets of stamens. In a third, the style will be as long as the longest set of stamens was in the other two flowers, and the two sets of stamens will occupy the two lower places. The explanation of this peculiar arrangement was first suggested by Charles Darwin; it will be convenient to postpone its consideration till later in the present chapter, when the relations between flowers and insects are under consideration.

In one spot, where the vegetation is thinner and less rank, two **Orchids** hold their own against the taller plants. These are the **Spotted Orchis, Orchis maculata**, and the **Tway-blade, Listera ovata.** It will be remembered that in a former scene (p. 43) another Orchis, the Early Purple, *O. mascula*, made its appearance among the Anemones and Primroses. The present will be a convenient time to pay a little attention to this very beautiful Order of plants. The **Orchideæ** are distributed all over the world, and number, according to Kerner, no less than eight thousand species. In the hot damp forests of the tropics many species grow, clinging to the branches of trees or feeding on decaying logs; the marvellous variety of shape and colour of the flowers of these exotics is known to every one who has visited the Orchid-house of a Botanic Garden. Compared to these gorgeous and amazing flowers, our British Orchids may appear insignificant; but they are full of interest and beauty. Some forty-four species inhabit the British Islands, representing sixteen genera. Three of the species are brown or yellowish leafless saprophytes, with curious branched root-masses; all the others have lanceolate or ovate parallel-veined undivided green leaves, and are perennial herbs. Many of the species produce annual tubers, singly or in pairs, in which food is stored up during the summer for next year's growth. A few have a creeping rhizome, which annually sends up a flowering shoot. All the British species have unbranched leafy stems (except the saprophytic species, which are leafless); and all bear the flowers in a terminal spike (in *Cypripedium* reduced to one or two flowers).

The **flowers of Orchids** are of very peculiar form, and have been made famous by the researches of Darwin[1] on the connection between their structure and the visits of insects. The ovary is inferior and lengthened, so that it looks like the stalk of the flower, which is in reality sessile. In almost all our British species the ovary twists as the flower comes into bloom, so that the parts that are normally uppermost become the lowest. The coloured calyx consists of three petal-like sepals, two lateral equal ones, and a central upper one (originally the lowest) usually of different size. The petals are likewise three in number, two of them lateral and equal, the third usually larger, and variously cut and lobed. In bud this large petal, the *labellum* or *lip*, is folded over the top of the other portions of the flower; in blossom it appears as the lowest member. The labellum is in some genera produced backwards into a tube in which honey is secreted; in other cases it is cup-shaped and bears honey in its front portion. The ovary is prolonged into the centre of the flower, this prolongation being termed the *column*. On it the stamens

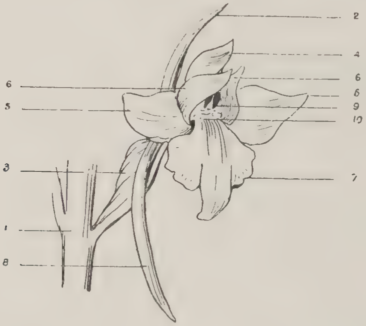


FIG. 46.—SINGLE FLOWER OF THE SWEET-SCENTED ORCHIS, *Habenaria conopsea*. ×2.

1, Axis of the flower-spike; 2, bract which subtends each flower; 3, the twisted ovary; 4, the upper sepal; 5, 5, the lateral sepals or wings; 6, 6, the lateral petals; 7, the lower petal or labellum; 8, the spur formed by the backward prolongation of the labellum; 9, the two anther-lobes; 10, the stigmatic surface.

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[1] "The Various Contrivances by which British and Foreign Orchids are Fertilised by Insects" (1862).

and stigmas are borne. In all British Orchids except the Lady's-slipper, *Cypripedium*, only one of the three stamens is developed; it consists of a two-lobed anther embedded in the upper part of the summit of the column. The stigmas are sessile, and in most species take the form of a flat sticky surface, placed just below the anther-lobes, and immediately overhanging the opening that leads to the bottom of the flower. This surface corresponds to two stigmas fused together; a third stigma is present, and is modified so as to form a knobby sticky structure of varied shape, the *rostellum*, situated between the stamen and the stigmatic surface. Each lobe of the anther splits open lengthwise, disclosing a large number of pollen-grains held together in a club-shaped mass by means of delicate threads. This pollen-mass is continued downwards into a slender stalk, which terminates in a sticky knob embedded in the rostellum. The position and form of these minuter parts of the flower differ in the several species almost as much as the colour and shape of the infinitely-varied perianth, but the above description will apply to our most familiar British Orchids. The beginner will find it difficult to follow the description of the structure of an Orchid-flower; but let him gather them for himself on any summer's day, and examine and compare the flowers; his difficulties will soon vanish, and he will find himself face to face with one of the most marvellous structures of the plant-world.

Let us see how this strange floral arrangement works. The pollen is not dispersed by the wind, for it is firmly tied together and held in its place. But let an insect—say a bee—visit the flower in search of honey. It alights on the conveniently-projecting lip, and thrusts its head into the cavity of the flower. In doing so, its forehead comes in contact with the sticky knob which terminates the club-shaped pollen-masses; this adheres sufficiently firmly to pull the pollen-masses—one or both—out of the anther as the insect's head is withdrawn, and the bee flies off to seek another flower with the pollen sticking to its head. Almost immediately the slender stalk bends through a considerable angle, so as to incline the mass forwards. The bee now alights on another flower of the same kind—it is a curious fact that on one journey an insect generally confines its visits to one kind of plant—and pushes in its head. On account of the bending of the stalk of the pollen-masses, they come in contact, not with the anther of the second flower, but with the stigmatic surface immediately below it, and thus pollination is effected. But I have rambled on too fast, and have described the mode of insect-fertilisation in the flowers which, of all others, are most highly specialised in this direction; it will be necessary to retrace our steps a little, and consider briefly the elementary facts concerning fertilisation, and the relations existing between **flowers and insects.**

In some species the transfer of pollen from one flower to another is not necessary, as the flower's ovary can be successfully fertilised by its own pollen; indeed, the structure of certain flowers is such that self-fertilisation *must* happen, and any other mode is impossible. In others, self-fertilisation takes place only in the absence of cross-fertilisation by insects, and is reserved as a kind of emergency method. In most cases, however, **cross-fertilisation** is a distinct advantage to the plant, as has been repeatedly proved by the careful experiments of Darwin and others; in many instances it is a positive necessity, the pollen of a flower having no effect whatever on its own stigma, or even acting on it as a poison. As a matter of fact, we find not only elaborate arrangements to secure proper cross-fertilisation by means of insects or of the wind, but equally striking contrivances to prevent self-fertilisation. Leaving out of account a few exceptional cases (such as *Zostera*, where the pollen is carried by water), the transfer of pollen from one flower to another is effected either by the wind or by insects.

To take first the case of wind-fertilised or **anemophilous flowers.** Considering the large amount of pollen that is sure to be wasted in flowers that rely for fertilisation on the wind, it is manifest that, if fertilisation is to be made sure, pollen must be produced in considerable quantity, and must be of a light and dust-like nature. It is also evident that the stamens should occupy an open and exposed position, that the wind may freely waft the pollen away; and that the stigma which receives the wind-borne pollen should be as prominent and present as large a surface as possible, that it may the better intercept the drifting grains. Further, since the visits of insects are not desired, a coloured and conspicuous corolla, attractive odour, or well of tempting honey, are unnecessary allurements, and can be dispensed with. All these conditions actually exist in most anemophilous flowers. Take the flowers of the Hazel, the Scotch Fir, the Plantains, the aquatic Pond-weeds, and the numerous Sedges and Grasses. All are small and inconspicuous; all have prominent anthers and stigmas, and produce much pollen; and, it should be noted, all are more or less gregarious in habit, and usually grow in large colonies, which renders fertilisation considerably easier.

Flowers which are fertilised by insects, or **entomophilous flowers**, exhibit a variety of complicated and ingenious devices which is truly amazing. In a brief sketch like the present, it will be possible merely to indicate the leading facts of the relations existing between flowers and insects, and leave the student of this intensely-interesting department of research to seek his information in larger works or treatises which deal specially with phenomena of this order. Sir John Lubbock's "British Wild Flowers Considered in Relation to Insects"[1] will be found sufficiently simple for the youngest reader; those who wish to go further should refer to the works of Sprengel, who, more than a hundred years ago, first drew attention to the relations between flowers and insects; of Darwin, who, by his now historic observations and experiments, laid the foundations of our present knowledge of this branch of science, and of Hooker, Bennett, Kerner, Müller, and others, who have since amplified and extended the mass of facts which he brought together.

In the first place, then, the visits of insects are of high importance to many flowers; are necessary, in fact, as may be easily proved by enveloping the flowers in muslin before they open, and noting that in consequence no perfect seed is produced. That the flowers are of equal importance to many insects is likewise manifest; if the latter are prevented from visiting flowers, they will die for lack of food. Both plants and insects have become modified so as to suit the requirements of their mutual relations. The flowers have developed brightly-coloured envelopes, which are advertisements for the insects that honey and pollen are there to be had for the asking. The shape of the flower is altered to suit its insect-visitors. In irregular flowers, such as Orchids and Labiates, the large lip projects as a convenient landing-place; some of the other petals or sepals arch over the tube of the flower, forming a roof for the due protection of the pollen and honey. The honey itself is secreted as a bribe to the insects to come and assist the species by dispersing its pollen, and the stigmas and anthers exhibit an infinite variety of beautiful devices for utilising the insect-visits with the greatest possible success and accuracy.

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[1] 1875.

Similarly, important modifications have taken place in honey-feeding insects, to render them the better suited to this mode of livelihood. It is in the form of the mouth and legs that these features are most marked. The lower lip becomes more and more prolonged in different species, till in the Humble-bees and Hive-bees it is exceedingly long and attenuated, fitted for extracting honey from even those flowers in which, as in the Orchid genus *Habenaria*, it is secreted in a slender spur far from the entrance of the flower. The legs likewise change, and in pollen-gathering species are covered with rows of stiff hairs, among which the pollen is safely carried. The mouths of flower-frequenting butterflies and moths are similarly modified into long tubes suited for sucking up the honey. In the Hawk-moths and Owlet-moths, these trunk-like mouths are developed in a very marked degree. Certain honey-feeding birds, the Humming-birds and Sun-birds, have enormously-prolonged beaks, which serve the same purpose. These, like the Hawk-moths, do not alight on the flower, but sip the honey while hovering in front of it. In flowers that are frequented by hovering animals like these, a platform for the visitor to alight on is not required; and not only is it absent in such plants, but the other portions of the perianth bend backwards, as if to be quite out of the way, and allow plenty of room for the rapidly-vibrating wings.

Considering the close proximity of the anthers and stigmas in most flowers, it is manifest that without special precautions there is a great probability of self-fertilisation, which, as already mentioned, is usually not beneficial to the plant. But ample preventive measures are to be found. A large number of anemophilous plants, which produce a cloud of pollen that could hardly fail to reach any stigma near at hand, are *diœcious;* the anthers and stigmas are on different plants, and self-fertilisation is impossible. Many others are *imperfect*, the anthers and stigmas being in different flowers, which prevents the fertilisation of any flower by its own pollen, but allows of its fertilisation by the pollen of another flower of the same plant. A more complete preventive measure is found in the fact that many flowers mature their stamens and stigmas at different times. In most cases it is the anthers that ripen first, and not until they have discharged their contents do the stigmas mature to receive the pollen of another flower, which, having come into bloom a little later, is now shedding it. Thus, in the Narrow-leaved Willow-herb, when the flower opens the style is bent down. Not till most of the pollen has been shed does it straighten, and the four feathery stigmas expand, ready to receive pollen from another flower. But to ensure fertilisation (self-fertilisation being better than none), before fading the stigmas bend back, so as to come in contact with the still remaining pollen on the anthers of the spreading stamens. In other cases the relative position of anther and stigma is such as to render self-fertilisation at least difficult.

Another peculiarly-beautiful arrangement is the **dimorphous** or **trimorphous** structure that is met with in a variety of insect-visited plants. In these the stamens and pistil are of different lengths in different flowers, the stamens of one flower being of exactly the same length as the style of another, and *vice versa*. The Primrose offers a familiar illustration. It will be remembered that in Chapter II. reference was made to the dimorphism which is a well-known feature of this plant. In some Primrose flowers the style is as long as the corolla-tube, and the anthers are half-way down, while in others the style is only half as long as the tube, and the stamens may be seen inserted at its top. In the Purple Loosestrife, referred to in the present chapter (p. 164), we saw that the stamens and style are of *three* different lengths (*trimorphous*). The meaning of this interchangeability of length in these parts of flowers was first explained by Charles Darwin, though it had been noticed by observers long before. As Sir John Lubbock remarks, now that Mr. Darwin has pointed it out, it is sufficiently obvious: "An insect thrusting its proboscis down a Primrose of the long-styled form would dust its proboscis at a part which, when it visited a short-styled flower, would come just opposite the head of the pistil, and could not fail to deposit some of the pollen on the stigma. Conversely, an insect visiting a short-styled plant would dust its proboscis at a part farther from the tip, which, when the insect subsequently visited a long-styled flower, would again come just opposite the head of the pistil." In case the insect visits two long-styled or short-styled flowers in turn, the only effect will be that by the second visit more pollen will be dusted on the same part of the proboscis; the chances are even whether it will visit, after leaving any flower, another of the same sort, or one of the other kind. It is easy to apply the explanation given above to the trimorphous flowers of the Purple Loosestrife, but in this species, on account of the three forms of flower, the number of possible ways in which the flower may be fertilised is increased. Perfect fertility, as Darwin's experiments have shown, results only from the fertilisation of the stigma of any flower by pollen from a stamen of corresponding length. It has been observed that the pollen-grains of the three forms of flower are of different size and colour, and that the seeds produced by the three forms are likewise of different size; and the same holds good of the dimorphous Primrose.

Before passing on to consider a few of the means adopted to secure insect-fertilisation in other plants, the arrangement found in a few other British Orchids deserves mention. The flower of typical members of the largest group of British Orchids, the **Ophrydeæ**, has been sufficiently described already, but each species has its own perfectly-fitting adaptations by which the pollen-masses, with absolute accuracy, reach the stigma of another flower. "A poet might imagine," says Darwin,[1] "that while the pollinia are borne from flower to flower through the air adhering to a moth's body, they voluntarily and eagerly place themselves, in each case, in that exact position in which alone they can hope to gain their wish and perpetuate their race." The beautiful **Bee-Orchis, Ophrys apifera**, is an exception, in that self-fertilisation appears to be its almost invariable rule. The pollen-masses are placed on two long arching pedicels, so slender that they droop under the weight of the pollen-masses till they dangle just in front of the stigmatic surface, to which a puff of wind causes them to adhere.

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[1] "Fertilisation of Orchids," p. 92.

The next largest group of British Orchids is the **Neottieæ.** In these the anther is attached to the column by its base only, not by its whole surface. The pollen is not so firmly fastened together, and the pollinia are not stalked. On the whole, the flowers of this group are not so complicated as those of the last. "*Epipactis* and *Goodyera* agree pretty closely in their manner of fertilisation with the *Ophrydeæ*, but are more simply organised; *Spiranthes* comes under the same category. *Cephalanthera* seems to be a degraded or simplified *Epipactis;* as it does not possess a rostellum—that eminently characteristic organ—and as its pollen-grains are single, it bears almost the same sort of relation to other Orchids which a wingless bird does to other birds."[1] In this group, **Epipogum**, a rare leafless forest-saprophyte, is remarkable in not having its flowers inverted. The large petal or lip is consequently uppermost, and arches over the rest of the flower. The anther and stigma are on the floor of the entrance of the flower, not on its roof as usual, and the pollen-masses adhere to the under surface of the body of insects instead of to the head. Two other members of this group, **Listera** and **Neottia**—the latter a brown leafless saprophyte like *Epipogum*—are remarkable as possessing an exceedingly sensitive and irritable rostellum; on receiving the smallest stimulus, even the lightest touch of a hair, a large drop of viscous fluid is forcibly and instantaneously expelled, which sets hard in a few seconds, and glues the pollen-masses as quick as lightning to the object—presumably the head of an insect—which caused the disturbance.

The **Epidendreæ** is a small group, so far as British plants are concerned, distinguished by having four waxy pollen-masses not attached to the rostellum. **Malaxis**, the tiny **Bog-Orchis**, resembles *Epipogum* in that its flowers are not turned upside down as usual. The labellum is short, and shaped like a roof, and arches over the essential portions of the flower; the central sepal occupies the position usually filled by the labellum, and acts in its stead as a platform for insects. This inversion of the flower is

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[1] Darwin, *l.c.*, pp. 93–95.

caused, not by the ovary being untwisted, but by its being twisted twice as much as usual. The other two members of the group are **Liparis Loeselii**, a very rare bog plant, and **Corallorhiza innata**, a leafless saprophyte living in boggy woods, with a curious branched coral-like root-mass. Lastly comes the beautiful **Lady's-slipper**, **Cypripedium Calceolus**, one of the rarest of British plants. It derives its name from the very large pouch-shaped labellum, which is yellow, the other segments of the perianth being purple and spreading. It differs widely from all our other Orchids in having two anthers.

To this brief account of the chief peculiarities of the flowers of our British Orchids it will be advisable to add some particulars relative to the general appearance of at least the commoner kinds. Several species of the genus **Orchis** are familiar plants. **O. mascula,** the **Early Purple Orchis**, we have found already flowering under the Hawthorns in May (see p. 43, and Fig. 10). It is one of the most welcome of our spring flowers and among the earliest of our Orchids. The leaves are tongue-shaped, smooth, and shining, and mottled with dark spots. The flowers are large, bright reddish-purple, in a lax spike. The tubers are roundish. While *O. mascula* adorns the woods and banks, **O. Morio**, the **Green-winged Orchis,** blossoms in our pastures. In general appearance it resembles the former, but the sepals arch over like a hood instead of spreading, and are veined with green; the whole plant is smaller, the leaves not blotched. A few weeks later the **Spotted Orchis, O. maculata,** is in full bloom in damp meadows and boggy places. The flowers are smaller than in either of the last, and arranged in a dense spike. They are pale pink, streaked and spotted with purple, but vary much in colour and marking. The leaves are pointed, and usually much mottled with pale purple. The lip or lower petal is large and broad, and deeply three-lobed. The stem is solid, the tubers palmate (divided like a hand). **O. latifolia** and **O. incarnata**, which also frequent damp places, resemble

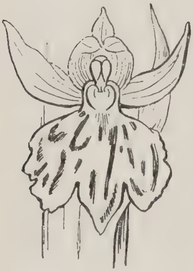

FIG. 47.
SINGLE FLOWER OF SPOTTED ORCHIS, *O. maculata.*
×2.

the last, and are exceedingly like each other. In both the lip is only *obscurely* three-lobed, and the stem is hollow, and the flowers usually much darker in colour than those of *O. maculata.* It is not easy to distinguish them from each other, but *O. latifolia* has leaves which are broadest half-way up, and have a flat tip, while those of *O. incarnata* taper from a broad base, and have a concave tip. **O. ustulata**, **Dark-winged Orchis**, is an easily-known little plant with all the perianth except the lip very dark purple and green, becoming lighter on the older flowers, and arching over like a hood; the lip is long, pink, and spotted, divided into three lobes, of which the large central one again splits into two lobes. It grows in dry pastures in England, not in Scotland or Ireland. **O. pyramidalis**, the **Pyramidal Orchis**, is likewise a well-marked plant, on account of its short, very dense spike of unspotted bright rose-red flowers. The sepals are spreading, the lip large, very broad, three-lobed, with a long spur behind, the leaves narrow, the tubers roundish. It is generally common in pastures, but local in Scotland and Ireland.

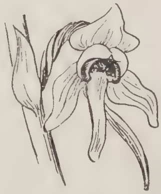

FIG. 48.
SINGLE FLOWER OF BUTTERFLY-ORCHIS, *Habenaria chloroleuca.* Natural size.

The genus **Habenaria** includes several species which are widely distributed. **H. conopsea**, the delicious **Sweet-scented Orchis** (see Fig. 46, p. 166), might be known by its powerful fragrance alone, which resembles that of Pinks. The purple flowers are borne in a long spike; the lip is broad and three-lobed, with a slender spur; the leaves are narrow, the tubers palmate like those of *Orchis maculata.* **H. albida** is a rarer plant of dry hilly places. It is fragrant, like the last. The flowers are whitish and very small, in a narrow cylindrical spike. The lip has three acute lobes. The tubers are palmate. **H. chloroleuca** and **H. bifolia**, the **Greater** and **Lesser Butterfly-Orchis**, are closely similar. Both have tapering undivided tubers, two large broad radical leaves, and a lax spike of greenish-white fragrant flowers. The lip is long, narrow, and undivided, with a very long spur. The principal difference between the two lies in the anther-lobes, which are *parallel* in *H. bifolia* and *diverge downwards* in *H. chloroleuca.* The former is a smaller plant, with whiter flowers in a narrower spike. These two are often considered varieties of the same species, but Darwin states that they differ from each other in structure more than do most species of the genus *Orchis*, and that they are fertilised in a different manner. **H. viridis**, the **Frog-Orchis**, is an inconspicuous little plant, growing in meadows, and liable to be passed over. It has palmate tubers, several alternate leaves, and a spike of brownish-green flowers. The lip is flat and hangs straight down; it ends in three lobes, of which the central one is the smallest; all the other perianth-segments arch over closely like a hood.

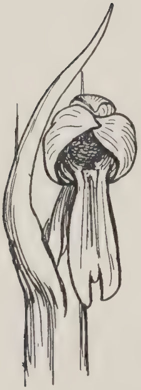

FIG. 49.—SINGLE FLOWER OF FROG-ORCHIS, *Habenaria viridis*. × 2.

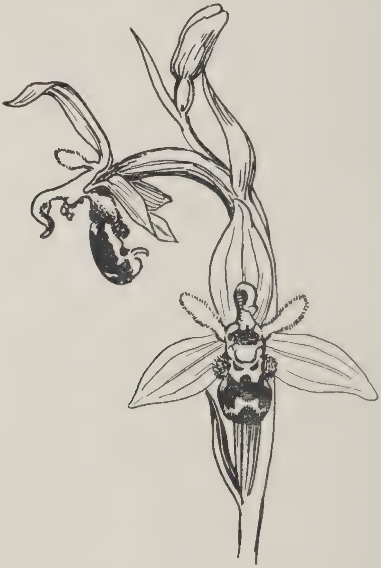

FIG. 50.—FLOWERS OF BEE-ORCHIS, *Ophrys apifera*. Natural size.

The genus **Ophrys** contains some of the most remarkable and beautiful of British Orchids—the Bee-Orchis, Fly-Orchis, and Spider-Orchis, so called from a resemblance of the flowers to these animals that is by no means fanciful. The **Bee-Orchis**, **O. apifera**, is the most frequent of the genus. It grows about a foot in height in pastures. The tubers are roundish, the stem sparingly leafy, the flowers few in number, and placed at intervals in a very lax spike. The three sepals are equal, ovate, bright pink; the two lateral petals small and downy; the labellum three-lobed, the lowest lobe large, very convex, velvety, mottled with brown and yellow, and remarkably like the hairy body of a Humble-bee, the other lobes small, hairy; the anther has a prominent beak-like hooked process. **O. muscifera**, the **Fly-Orchis**, is the only other species of at all frequent occurrence. In it the flowers are much smaller, the sepals green, the upper petals very narrow, and, like the lip, reddish-brown or purplish. The lip is flat, three-lobed, its large central lobe bifid; and it bears a large pale spot.

Of **Spiranthes**, **S. autumnalis**, **Autumnal Lady's-tresses**, the little plant represented in the drawing, is the only one of the three British species that is not extremely rare. It grows in dry pastures, and has small greenish-white flowers, with a delicious perfume. Its one-sided flower-spike, twisted in the way characteristic of the genus, and its late flowering (August-September) render it easily recognisable. When in flower, the root-leaves of the next year's stem are already above the ground. The rare **S. Romanzoviana**, which in Europe is known only from three stations in Ireland, is illustrated on the title-page by a photograph of specimens collected in Co. Londonderry in 1894.

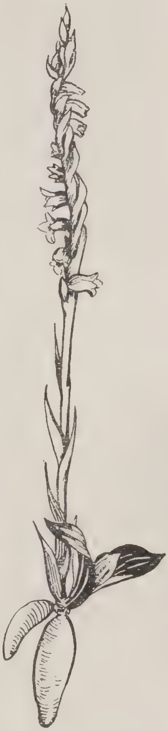

FIG. 51.—AUTUMNAL LADY'S - TRESSES, *Spiranthes autumnalis.* Two-thirds natural size.

The **Tway-blade**, **Listera ovata** (Fig. 52), is well distinguished by its opposite pair of large egg-shaped leaves on an otherwise leafless stem. Its flower-spike is long, the flowers yellowish-green, small, the lip very long, narrow, bifid at the end, the ovary short and swollen. The root consists of a number of fleshy fibres without tubers. The tiny **L. cordata** is similar, but has rather heart-shaped leaves, and the lip has a pair of small lateral lobes. It is a very slender little plant, growing among moss under Heather in mountainous places.

Neottia Nidus-avis, the **Bird's-nest Orchis**, is a brown leafless saprophyte found under trees—generally old Beech-trees. The whole plant is so much the colour of the dead Beech-leaves that it may easily be overlooked, even though it is usually a foot in height. This curious Orchid might easily be mistaken for a Broom-rape, so similar is its general appearance to some of the species of that parasitic genus. A glance at its flowers, however, at once shows that it is an Orchid. The root consists of a dense mass of succulent fibres, from which it derives, somewhat fancifully, its Latin and English names.

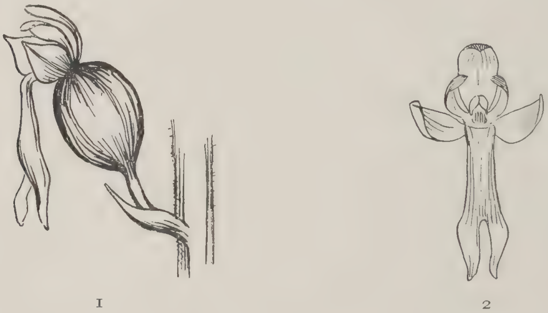

Fig. 52.—Single Flower of Tway-blade, *Listera ovata*. × 2.
1, Side view; 2, Front view.

Of the four species of **Epipactis** or **Helleborine**, two are of tolerably frequent occurrence. **E. latifolia** is a tall plant, sometimes a yard in height, with numerous broad-ribbed, thin, alternate stem-leaves, and a long lax spike of green and purple flowers. The root-stock is slender and creeps slightly; the leaves ovate. The sepals and upper petals are all about the same size, ovate, greenish; the lip much contracted in the middle, marked with yellow, white, or purple, and distinguished by being "roundish cordate with a small recurved point." Several closely-allied forms are described, sometimes as sub-species of this, sometimes as separate species. **E. palustris** is a beautiful plant, growing in moist places. The root-stock creeps, producing annually a bunch of root-fibres and a flowering shoot. The stem is about a foot high, with broad leaves and large and beautiful flowers, white or pink. The curious broad hanging fringed lobe of the lip of this species will alone identify it.

The genus **Cephalanthera** includes several handsome *Epipactis*-like plants with large and handsome flowers; none of them, however, can be designated as of frequent occurrence. The tiny **Bog-Orchis**, **Malaxis paludosa**, is rather more frequent, being found in 45 out of the 112 botanical subdivisions into which England, Wales, and Scotland have been divided, and it is so inconspicuous that it is probably more frequent than would appear from this census. It is a minute plant, greenish-yellow in every part, with one or two broad, short fleshy leaves and a short flower-spike. It grows among *Sphagnum* in bogs, and has been already referred to (p. 45) as producing on the margins of its leaves numbers of little bulbils, which develop into new plants.

The remaining genera of British Orchids, *Aceras*, *Herminium*, *Goodyera*, *Epipogum*, *Corallorhiza*, *Liparis*, and *Cypripedium*, are represented only by plants of considerable rarity, for descriptions of which botanical manuals should be consulted.

Space will permit of only a passing glance at the mode of fertilisation of other entomophilous plants; but when one realises the delicacy and perfect accuracy of the mechanism of Orchids, so beautifully adapted to the circumstances of each particular case, one feels that he has indeed viewed the *chef d'œuvre* of nature's fertilising machinery, and that no further facts can increase the wonder. The flowers which are most adapted for and dependent on insect-pollination are, like the Orchids, irregular, with the axis of the flower more or less horizontal—the *Leguminosæ*, *Scrophularineæ*, and *Labiatæ*, for instance. The advantage to the flower of this form of structure is that insects are compelled to approach in one particular way. They alight on a portion set apart for that purpose; they are guided to the honey by certain markings which serve as sign-posts, and in the act of sipping the nectar they deposit pollen on the stigma and take up fresh pollen from the anthers. The ease, speed, and accuracy of the function, especially as one sees it in the Orchids, recalls the absolute precision of the apparatus used on a fast mail-train, by which letter-bags from other places are discharged and local letters picked up at each station in the twinkling of an eye. In **Leguminosæ**, the Order of familiar Pea-like plants, the pollen in many species, such as the Clovers, Bird's-foot Trefoil, and Lady's-fingers, falls before the flower opens, and collects in the boat-shaped keel (see p. 8). When a bee alights on the flower, its weight forces out a small quantity of the pollen, as well as the tip of the stigma, against the bee's body. This is, indeed, a kind of natural "penny-in-the-slot" arrangement. Another strange mechanical device is found in the genus **Salvia.** The anthers are borne at the top of an upright curved rod, which is hinged in the middle to the filament, and hangs over the tube of the flower. When an insect inserts its head, it pushes inwards the lower end of the hinged rod, with the effect that the pollen-bearing upper end swings down and strikes the insect's back. But this is not all, for the style continues to grow after the stamens have shed their pollen, so that in an older flower the stigma occupies the precise position of the toppled-over anther, and therefore receives the ejected pollen. In the **Heaths**, as we have seen (p. 112), the anthers are placed close together in a ring near the mouth of the bell-shaped corolla, and they possess curious reflexed horns. When a bee inserts its tongue into the flower, it pushes against these appendages, and in consequence the anthers are released from their mutual contact and the pollen escapes. In plants which bear a large number of flowers in close proximity, such as *Compositæ*, *Dipsaceæ*, and *Umbelliferæ*, it is manifest that the chance of fertilisation from other flowers of the same plant is much increased. This is effectually guarded against in most of the species by their being **proterandrous**; the stamens of each head or umbel ripen before the pistil, and the pollen is all shed before the stigma is mature. Most plants of these Orders are *par excellence* entomophilous. The grouping of the flowers in heads renders them much more conspicuous, and consequently more likely to receive insect-visits, than if the flowers were arranged singly. The honey in all is easily reached. In

Umbelliferæ it lies in a little open saucer in the centre of the flower, free to all comers; in *Compositæ* it is stowed away at the bottom of the short tube. The Geraniums furnish an instructive series, as pointed out by Sir John Lubbock.[1] Species like the Meadow Crane's-bill, *G. pratense*, which rely on insects, and are incapable of self-fertilisation owing to their being proterandrous, have large, showy, attractive corollas; some others, such as *G. pyrenaicum*, which are only partially dependent on insects, as the stigma is mature before all the anthers have faded, have smaller flowers; while *G. pusillum*, which is generally self-fertilised, has quite inconspicuous petals.

With a reference to **cleistogamous flowers** the present chapter must close. These are flowers in which the principle of self-fertilisation is carried so far that they do not open at all. The stamens ripen their pollen, and the pollen fertilises the ovary, and seed is produced, all within the closed envelope of the flower. But it is to be noted that no plant produces *only* cleistogamous flowers. Cross-fertilisation is too important to be altogether set aside; and all the plants which produce cleistogamous flowers bear also flowers adapted for cross-fertilisation. In cleistogamous flowers a showy corolla would be of no service; and it is found that in such flowers the petals are mostly quite rudimentary, though the ordinary flowers of the species may have a large and brilliant corolla. The anthers, which in all cleistogamous flowers lie close to the stigma, in some do not open and emit pollen; pollen-tubes grow out of the closed anther and find their way to the stigma. Plants bearing cleistogamous flowers have, as it were, a second string to their bow. In case, through lack of insects or other causes, the normal flowers do not mature seed, these closed flowers supply the necessary part and ensure the perpetuation of the race. In many of our wild-flowers cleistogamous flowers are to be found; notably in the Violets, of which, according to Bentham, *V. tricolor*, the Wild Pansy, is the only one in which the ordinary flowers generally produce seed. In *Lamium amplexicaule*, a common species of Dead-Nettle, small cleistogamous flowers may also be found; they are frequent in several species of Knot-grass (*Polygonum*), and occur in a number of other plants. In certain species which frequent the sides of lakes and streams, such as the Mudwort, *Limosella aquatica*, and the Water-Purslane, *Peplis Portula*, the flowers open under normal conditions, but in case of a flood submerging the plants the flowers fertilise themselves without opening.

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[1] "British Wild-Flowers in Relation to Insects," p. 43.

As we stand in this fragrant meadow, listening to the incessant hum of the insects and the gentle rustling of the breeze among the grasses, we are witnessing an all-important part of the never-ending life-processes by which the whole vegetable world is maintained, and by which in great measure it has been built up. In the warm glow of the summer sun and the stillness of the noontide we might imagine that Nature was asleep, lulled by the heavy droning of the bees. But could we ask the question, Dame Nature would answer us as, under the guise of Mother Carey, she answered little Tom in the "Water-Babies"—"I am never more busy than I am now." For Nature's processes work quietly and surely, and are going on all the time; and the hum of the bees among the Meadow-sweet is but the echo of the whirr of the machinery on which we ourselves, and the whole animal and vegetable world, are dependent for very existence.

SCENE IX

AMONG THE CORN—A STUDY IN WEEDS

(Portmarnock, Co. Dublin, *August* 1896.)

> "Here thistles stretch their prickly arms afar,
> And to the ragged infant threaten war;
> Here poppies, nodding, mock the hopes of toil;
> Here the tall bugloss paints the sterile soil;
> Hardy and high above the slender sheaf
> The shining mallow waves her silky leaf;
> O'er the young shoot the charlock throws a shade,
> And clasping tares cling round the sickly blade."—Crabbe.

An hour may be well spent in this cornfield. The grain is already turning golden; everywhere scarlet Poppies blaze; tall Catchflies and Corn-Cockles rise among the crop, and, hidden from view by the tall stems, a luxuriant and varied growth of low-growing weeds invites our attention. Round the edge of the field stretches a variegated border where weeds of every size and shape are running riot. The ground here is flat and sandy. Two fields away rise the sand-dunes of Portmarnock—dear to the lovers of golf—stretching into the distance on either hand. The soil of our cornfield is poor and the crop light; but the many wild-flowers which have invaded it appear thoroughly at home, and grow luxuriantly.

The **Poppies** are by far the most conspicuous of these. Their gorgeous blossoms paint the yellow field with patches of brightest scarlet. Two species are here, but it is the **Corn Poppy**, **Papaver Rhæas**, that contributes chiefly to the decoration of the scene. Its flowers are more rich and full and of a deeper colour than those of **P. dubium**, which grows with it. Two other British Poppies there are which have also red flowers—**P. Argemone**, with much smaller starved-looking petals, each with a large black spot at its base; and **P. hybridum**, with smallish crimson petals, also with a dark basal spot. The corollas of the last two fall very soon, so that it is difficult to preserve specimens with the petals adhering. This matters the less, as the four species may be easily known by their fruit. *P. Rhœas* has *short smooth* capsules; in *P. dubium* they are *long* and *smooth;* in *P. Argemone, long* and *bristly;* in *P. hybridum, short* and *bristly.* These well-marked differences are shown in the figure; even when only flower-buds are obtained, the species may be determined by this means. In general appearance the four species are alike, and all are annuals frequenting light soils and gravelly places. All are hairy plants with much-divided leaves and milky juice. In all, the calyx consists of two large bristly sepals, which entirely enclose the flower in bud, and fall off as it opens. All have four petals, and many stamens surrounding the urn-shaped ovary, which is crowned with the peculiar stigmas. These are four to eight in number, and are arranged in a radiating manner on a flat disk. The capsule opens by pores just below the edge of this roof. Inside the capsule the numerous seeds are borne on a series of flat vertical plates that spring from the walls and radiate towards the centre. Note the way in which the petals are crumpled in bud, just as one might crumple a piece of paper in the hand; yet they expand quite smoothly. The British Poppies are widely distributed, but in general become rarer as we pass northward through Scotland and westward across Ireland. The **Opium Poppy, P. somniferum**, is sometimes found apparently wild in dry

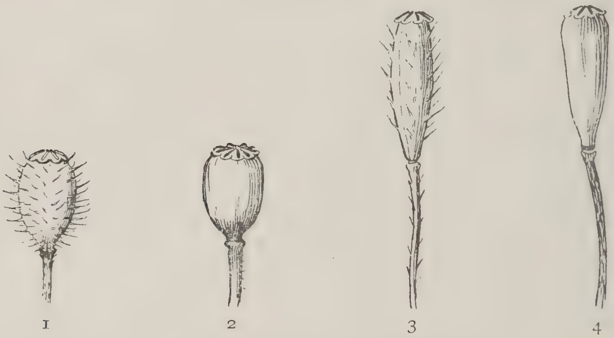

FIG. 53.—FRUIT OF THE BRITISH POPPIES.
1, *P. hybridum;* 2, *P. Rhœas*; 3, *P. Argemone;* 4, *P. dubium.*
Natural size.

ground, though not a true native. It is easily known by its very large pale lilac flowers with a large purple stain at the base of each petal, and its glaucous undivided leaves. Allied to *Papaver* is **Meconopsis cambrica**, the **Welsh Poppy**, a pretty perennial plant with smooth green pinnatifid leaves and yellow flowers; the flowers differ from those of the Poppies proper in having the radiating stigmas raised on a short stalk; and the fruit opens by larger triangular valves. The Welsh Poppy is a rare species; it grows in mountainous districts in the west of England and in Ireland. If to the above plants we add the Horned Poppy and the Greater Celandine (mentioned on pp. 73–75), we shall have made the acquaintance of all the British members of the Poppy tribe, or *Papaveraceæ*.

One of the tallest weeds that grow among the corn is the **Field Scabious, Scabiosa arvensis**. This plant belongs to the Order **Dipsaceæ**, a small group closely allied to *Compositæ*, but differing particularly in each flower of the head possessing an involucel or kind of outer calyx, which closely clasps the ovary. *Scabiosa arvensis* has hairy leaves, of which the lower are usually almost entire, while the opposite pairs of stem-leaves are pinnatifid. The stems are tall and slender, and bear flattish heads of lilac flowers an inch to an inch and a half across. The inner flowers are redder in colour than the outer ones, and the latter, as mentioned on a previous page (p. 164), have larger corollas, which are irregular owing to the greater growth of the outer lobes. The heads are surrounded by an involucre of ovate bracts. Examine a specimen in fruit. The involucel or outer calyx is oblong and somewhat four-sided; it terminates in four blunt points, and is open at the top, allowing the many narrow teeth of the calyx, with which the seed is crowned, to stand up freely in the centre. **S. Columbaria** bears a considerable resemblance to *S. arvensis*, but is much smaller in all its parts. The calyx has only five teeth instead of eight, and the involucel has eight furrows instead of four, and a membranous margin without teeth. The plant grows on a limestone soil in England and

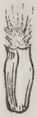

FIG. 54. SINGLE FRUIT OF CORN SCABIOUS, *Scabiosa arvensis*. Twice natural size.

Scotland. The third British species is the common and well-known **Devil's-bit, S. succisa**, which derives its name from its abruptly truncate root-stock. It has blunt undivided leaves and hemispherical heads of deep-blue flowers on branched stems one to two feet high, and often grows so abundantly in upland meadows and on heathy ground that in August, when most of our wild-flowers are over, it turns the green and brown of the foreground to purplish blue.

The tall forked stems of the **White Campion**, or Evening Campion, **Lychnis alba**, standing here and there among the nodding corn, raise its white flowers conspicuously above the general level of the crop. This and its ally, the **Red Campion, L. dioica**, are familiar wild-flowers. In habit they closely resemble each other. Both have downy broadly-lanceolate leaves, which, like almost all the plants belonging to the Order (**Caryophyllaceæ**), are undivided and borne in opposite sessile pairs. Both have large egg-shaped calyxes; these and the upper part of the stem are clothed with sticky hairs; and both have a corolla of five petals, narrow and parallel below, broad and spreading above, where each is cut into two lobes by a deep notch. About half-way up each petal bears a pair of projecting scales on its surface, and on the margin adjoining a small lobe on each side. Both plants are diœcious. *L. alba* is a larger plant than *L. dioica*, and grows in open dry places, while *L. dioica* haunts woods and shady places. The flowers of *L. alba* are large and white, those of *L. dioica* rose-colour. The best distinguishing character lies in the fruit-capsule, which is *conical with erect teeth* in *L. alba*, *globular with recurved teeth* in *L. dioica*. Two other species of *Lychnis* are frequently met with. **L. Flos-cuculi** is the well-known **Ragged-Robin**, a plant of marshes, distinguished by its red petals, each deeply cut into four narrow spreading lobes, and bearing a pair of narrow teeth near the base. **L. Githago**, the **Corn-Cockle**, is distinguished by the broad entire petals of its large purple flowers, and by its peculiar calyx, egg-shaped and ribbed below, continued above into five very long herbaceous segments, which exceed the petals. It is an annual weed in cornfields. The remaining two British species of *Lychnis* are rare plants. **L. Viscaria** grows on trap rocks in Wales and Scotland. The leaves are dark green and narrow, the unbranched stem is viscid at the nodes, the petals are dark red and slightly notched. **L. alpina** is an alpine plant which has been found in the Lake District and on the Clova Mountains. It is small and tufted, with smooth lanceolate leaves and simple stems, which are not viscid, and which bear a rather dense cluster of red flowers.

Closely related to *Lychnis* is the genus **Silene**, or **Catchfly**; it differs in having three styles instead of four or five. A familiar member of this genus grows among the corn in our field. This is **S. Cucubalus**, the **Bladder Campion.** Note the much inflated, pale, smooth calyx, netted with darker veins, and the deeply-bifid white petals without scaly projections. **S. maritima**, the common **Sea Campion**, closely resembles the last. It has a similar calyx, but the petals are only notched, and have two distinct scales projecting from their upper surface. *S. maritima* is, besides, a smaller, more spreading plant, with more fleshy glaucous foliage and larger flowers. The curious balloon-like calyx distinguishes these two plants from any other member of the Order. The remaining species of the genus are as follows: **S. anglica**, **English Catchfly**, is a branched, hairy, sticky plant, with very small flowers arranged alternately in lax racemes. The calyx grows after flowering as the capsule which it encloses swells, so that the fruit is much more conspicuous than the tiny white or pink flower. It usually occurs as a weed among the undergrowth of sandy cornfields. **S. noctiflora** has been already referred to (p. 26) as an example of a night-flowering plant. In appearance it closely resembles a small *Lychnis alba*, but its ten-ribbed calyx and flowers tightly closed except at night, its greater stickiness, and the absence of barren shoots or woody root-stock—for the plant is an annual—will prevent its being confused with its larger cousin. The other species of *Silene* may be all accounted rare. **S. acaulis**, the **Cushion Pink**, which we shall meet with on our next ramble (p. 215), is a tiny alpine plant, forming dense cushions, which in June or July are starred with pretty little pink flowers on very short stalks. **S. nutans**, or **Nottingham Catchfly**, has foliage rather like that of *S. noctiflora*, but the flowers are borne in a branched terminal panicle. The white petals are narrow, split into two long segments. It grows on chalky ground in England and Scotland. **S. conica** is an annual found in sandy fields. It is well distinguished by its stem branched above, small red corolla, and egg-shaped calyx much enlarged in fruit, and bearing about thirty narrow furrows. **S. Otites,** the **Spanish Catchfly,** is not at all like any other of the genus. The small leaves are mostly radical, and grow in clusters; they are broadest near the top. The flowers are borne in a long raceme with short tufted branches, and are numerous. They are small, with a yellow corolla and conspicuous stamens. *S. Armeria* and *S. italica* are introduced species, sometimes found growing wild.

Many of the Catchflies and Campions, it may have been observed, are furnished with sticky hairs on the calyx, or on the upper portion of the stem, or in rings at the nodes of the stem; or, as in *Lychnis Viscaria*, the smooth stem is covered with a viscid secretion below each of the upper nodes; or, as in *Silene anglica*, the whole plant is clammy and sticky. The object of these viscid secretions has been fully dealt with by Professor Kerner in his charming book, "Flowers and their Unbidden Guests." While the labours of many workers have abundantly shown the varied devices by which plants entice useful insects to visit their flowers, Kerner's book is written to prove that a corresponding wealth and variety of contrivances are found, the object of which is to prevent the intrusion of animals which would be hurtful, or, at least, of no service to the plant. "As hurtful may be characterised all such animals whose visits interfere with or prevent the speedy transfer of pollen from flower to flower. Such are small wingless animals, which must of necessity reach the honey and pollen on foot. Let us consider the case of one of these little pedestrians. Suppose it to have reached a flower and covered itself with pollen; it has now before it, in order to transfer this pollen to a stigma of another plant, a long and toilsome journey, beset with dangers for the pollen, quite apart from the length of time taken. The pollen may be so easily rubbed off on the journey by hairs and other structures encountered, or it may be washed off by rain. Then, even if a second flower be attained, what are the probabilities of its being in a receptive condition? How otherwise it is with the lightly-flying insects and humming-birds! They dart from plant to plant with extraordinary rapidity, and visit half-a-dozen flowers within a minute or so, thus transferring the pollen new and fresh. Winged insects and humming-birds are ideal agents for the crossing of flowers, and are the most welcome of all guests.

"But even of these fleet emissaries all are not equally welcome. Of what service is it to a plant if its pollen is not deposited on the proper spot—on the stigma, where it can develop pollen-tubes—be the transfer accomplished ever so quickly? Let us suppose a tiny fly entering the flower of a Foxglove. It alights on the lower lip of the corolla and makes its way to the honey at the base of the flower, where the honey is, without touching the stigma or stamens placed just below the upper lip. Having satisfied itself, it retreats by the same route. What advantage does the flower get from the visit of this particular insect? None. And more than this, it has been robbed of a portion of that honey on which it relied to allure some larger animal which would unintentionally stroke the anthers and stigma with its body. By the admission of small flies to Foxglove flowers consequently no transfer of pollen would be effected. Thus we see that not all flying animals are desirable visitants; that many insects, which, in consequence of their shape and size, are unable to promote a transfer of pollen, must be regarded as unbidden guests, and prevented access to the honey."[1]

In "Flowers and their Unbidden Guests" Kerner classes the protective appliances used by plants against insects injurious to the flowers under eight heads: 1. Secretion in the flowers of distasteful substances; 2. Isolation in water; 3. Viscid secretions; 4. Prickles; 5. Hairy formations; 6. Parts of the plant, and especially parts of the flower, being bent, or dilated, or crowded together; 7. Temporary suspension of the functions of those parts of the flower which attract insects; 8. Diversion of visitors from the flower. One or two familiar examples of each, taken chiefly from Kerner's work, may be mentioned. As examples of the secretion of distasteful substances, he cites the ferns and mosses, which are, with few exceptions, not relished by animals. The Good-King-Henry, *Chenopodium Bonus-*

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[1] Kerner, "Natural History of Plants," ii., pp. 230, 231.

Henricus, and the Common Lady's-mantle, *Alchemilla vulgaris*, though growing in pastures or on roadsides, are let alone by herbivores; similarly the Henbane, *Hyoscyamus niger*, and other poisonous plants. Of flowers which are protected by isolation in water, we had numerous examples in our riverside scene—such as Water-Lilies, Frog-bit, Bladderwort, Arrowhead, Water-Plantain. The Teasel, whose pairs of connate leaves form bowls which are constantly full of water, isolating each node of the stem from the adjoining ones, is a striking instance of another kind; and the fact that it has been suggested with equal reason that these bowls may serve another purpose—that of insect-traps by which the plant is nourished—does not impair the argument based on their efficacy as insect-stoppers. Of viscid secretions we have had excellent examples already in *Lychnis Viscaria*, *Silene noctiflora*, and *S. anglica*. Kerner collected sixty-four specimens of small dead insects off a single inflorescence of *L. Viscaria*, and to show the variety of animals destroyed by protective appliances, he instances *Silene nutans*, from the viscid flower-stems of which, in the Tirol, he took insects of sixty different kinds—ants, ichneumons, beetles, bugs, flies, &c. The sticky stems of Petunias, Moss-Roses, and other familiar plants, no doubt act as highly efficient barriers against crawling invaders.

Of prickly formations for the stoppage of uninvited guests the Carline Thistle (illustrated on p. 84) offers an excellent example. The bracts or phyllaries which compose the involucre present an insurmountable barricade to insects approaching the flowers from below. Most of our common Thistles have similar prickly involucres. The coarse bristles which clothe the stems of the Hemp-Nettle, *Galeopsis Tetrahit*, and other plants, are aggregated just below the swollen joints, and there form downward-pointing *chevaux-de-frise* that no small insect could pass. The close growth of hairs on many stems and leaves and on the calyxes of flowers are effective both in keeping small animal pests at a distance and in keeping these parts of plants warm and dry. More striking as insect-barriers are the rings of hairs found in the corolla-tube of the Dead-Nettles, *Lamium*, and the Woundworts, *Stachys*. In these every inducement is offered to insects to visit the flowers: but insects too small to be useful in fertilising the plants, even if they arrive by flying, are prevented from partaking of the honey by the ring of hairs, as they cannot pass it, and their probosces are not long enough to reach from the barrier to the honey-store. As examples of his sixth division—access to flowers being impeded by parts being bent, crowded, &c.—Kerner cites the flowers of Snapdragon and Toad-Flax, the closed lips of which a small fly cannot enter; but a bee can push them asunder, and thus obtain access to the interior of the blossom. In other plants—familiar examples of which will occur to the reader—the same purpose is served by the narrowing or lengthening of the posterior honey-bearing portion of the flower, so that no insect-organ but the elongated proboscis of a bee or butterfly can reach the nectar; note, for instance, the honey-bearing tubes of the Butterfly-Orchis.

As examples of the closing of the approach to the honey by crowding together of the parts, the numerous stamens of *Dryas*, *Potentilla*, &c., may be quoted. Another arrangement which answers the same purpose may be observed in the flowers of *Linum catharticum* and *Geranium Robertianum*, the petals of which bear ridges on the lower portion of their faces, which "jut outwards towards the centrally-placed ovary with its surrounding stamens, and are closely pressed against it like so many buttresses. This results in the formation of five narrow passages leading directly to the nectar, which is secreted by the base of the filaments at the bottom of the flower." In other flowers, such as certain Gentians and many Convolvuluses, the thickened filaments serve the same purpose, blocking the passage into the flower save for five small tubular openings, through which only the long tongue of a bee or other "bidden guest" could reach the honey. As examples of the temporary suspension of the functions of the attractive portions of flowers as a means of hindering unwelcome insect visits, Kerner cites the case of night-flowering species, such as *Silene noctiflora* and *S. nutans*, the blossoms of which are by day tightly closed, while by night, when the nocturnal insects required for their fertilisation are abroad, they expand, and by their fragrance and pale colour attract these welcome visitors. Lastly, there is the diversion of animals from the flowers by the offering of counter-attractions. The bribe usually offered is honey, which is secreted by the leaves or stems, so that insects crawling up the plant may satisfy themselves without interfering with the mechanism of the flowers, or robbing them of the nectar-store on which they rely to attract more important visitors. This whole subject is a most curious and interesting one, and the reader wishing to pursue it should study Kerner's essay, which was some years ago (1878) translated into English under the editorship of Dr. W. Ogle.

In the rough ground that fringes our cornfield the **Charlock, Brassica Sinapistrum** (= *Sinapis arvensis*), brightens the coarse belt of weeds with an abundance of yellow flowers. This is one of our commonest weeds, often covering a whole field with a sheet of yellow, and seldom found except upon cultivated or newly-disturbed ground. It is a representative of a very important genus, to which belong the plants from which have been derived by cultivation the many varieties of Cabbage—Savoys, Broccoli, Brussels Sprouts, Cauliflowers, Red Cabbage—all varieties of **Brassica oleracea**, a rare sea-cliff plant of Wales and the south of England. The Turnip is also the progeny of a wild *Brassica*, while the seeds of closely-allied forms yield colza oil and rape oil. The seeds of *B. alba* and *B. Sinapioides* (= *B. nigra*) supply the mustard of our tables; the young leaves of *B. alba* are used as a salad; Rape-seed is a favourite food for cage-birds; so every portion of the plant—root, stem, leaves, flowers, or seeds—in different species is of value.

The Charlock belongs to a division of *Brassica* characterised by having *spreading* sepals, often placed in a separate genus, **Sinapis.** The British species of *Sinapis* are three in number. All are annual weeds, with rough lyrate (pinnatifid with the upper lobes larger and a very large terminal lobe) leaves, branching stems, and yellow flowers. If we find by the spreading sepals that a cabbage-like plant belongs to this sub-genus, the species is best determined by the fruit. Figs. 55, 56, 57 show how they may be distinguished. The pods of **B. Sinapistrum** are more or less spreading, rather long, straight, and glabrous; the terminal seedless portion or beak is short and conical. In **B. alba** the pods spread widely and are bristly; the beak is long, flattened, and curved. **B. Sinapioides** has short erect pods, much smaller than those of either of the others; and each bears four prominent ribs, so that the pods are quadrangular. From these well-marked plants the many wild, half-wild, or cultivated varieties of Cabbage and Turnip, which often grow in fields along with them, may be known by their *erect* sepals; and they have all spreading smooth pods two to three inches long. The grouping of these plants under species and varieties varies much in different works. **B. oleracea,** however, is distinct and native, growing, as already remarked, on southern sea-cliffs; it is known by its glaucous, glabrous, obovate lobed lower leaves and elongate raceme of flowers. **B. monensis** is a native of the sandy western sea-shores of England and Scotland; it is distinguished by its elegant deeply pinnatifid leaves. **B. Cheiranthus** is a hispid and branched plant closely resembling the last, found in Cornwall.

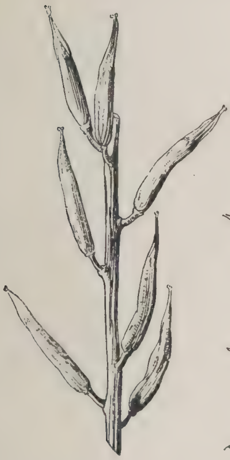

FIG. 55.—FRUIT OF CHARLOCK, *Brassica Sinapistrum.* One-half natural size.

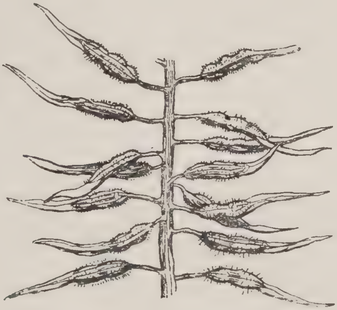

FIG. 56.—FRUIT OF WHITE MUSTARD, *Brassica alba.* One-half natural size.

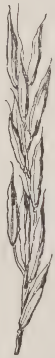

FIG. 57. — FRUIT OF BLACK MUSTARD, *Brassica Sinapioides.* One-half natural size.

Among the Charlock and Goosefoot and Orache, the Common Mallow, *Malva sylvestris,* has established itself, and out among the corn grows a single plant of the Musk-Mallow, *M. moschata.* Beautiful plants these, with branching leafy stems which produce an abundance of showy purple or pink blossoms. They are representatives of a Natural Order, the **Malvaceæ**, small as far as British plants are concerned, for of some thousand known species only six are natives of our Islands. Pluck a flower of *M. sylvestris* and observe its structure. The calyx is hairy and five-cleft, and immediately below it is a group of three separate narrow bracts, forming a kind of outer calyx. The five petals are separate, wedge-shaped, very large and showy, at the base of the tube formed by the fusing together of the filaments of the many stamens. The anthers have only one cell—an unusual feature, but characteristic of *Malvaceæ.* The numerous styles rise in a column from the many-celled ovary up the interior of the staminal tube, and expand into a cluster of stigmas in the middle of the anthers. Examine a fruit. The persistent calyx and outer calyx closely invest the many carpels, which are set in a circle, like a thick curtain-ring; a striking arrangement by which we may easily know any member of the Order. Of **Malva** three species are native in these islands. **M. sylvestris** is much the commonest, abounding in dry waste places, especially near houses, but rare in Scotland. It is known by its erect stem, five- or seven-lobed serrate leaves, and glabrous wrinkled fruit. **M. moschata**, of which a stray plant grows among the corn, is the handsomest of the native species, on account of its beautifully-cut foliage and very large pink or white blossoms. Its *hairy* fruit and upper leaves divided into linear segments render it easily diagnosed. The third species, **M. rotundifolia**, is a spreading prostrate plant of roadsides, with downy five- or seven-lobed leaves and small pink flowers, and downy smooth fruit. The other British Malvaceæ belong to two genera, **Lavatera** and **Althæa.** The former is represented by but one native species, **L. arborea**, the **Tree-Mallow**. Its English name well describes the plant, which resembles a Mallow grown four to eight feet high. The leaves are seven-lobed and velvety, the stem very tall and woody, the flowers pink with a dark purple centre. Their structure is similar to that of the flowers of *Malva*, with the difference that the outer calyx consists of three large and broad lobes, which are joined in their lower part. This handsome plant inhabits rocks near the sea, and is rare. The third genus, **Althæa**, has two British species, *A. officinalis* and *A. hirsuta.* This genus differs from *Malva* and *Lavatera* in having an outer calyx composed of six to nine lobes, instead of three. **Althæa officinalis** is the **Marsh-Mallow,** long used in medicine as a demulcent and emollient. It is a stout, perennial, downy, Mallow-like plant, with greyish cordate-ovate leaves and numerous pink flowers, and grows wild in marshy places near the sea in the southern portions of England. **A. hirsuta** is very rare; it is an annual hispid plant with tripartite upper leaves and small rose-coloured petals, no longer than the double row of sepals. It has been found in Somerset, Kent, and Herts.

Let us now examine the thicket of low-growing plants that hide among the crop, sheltered alike from heat and cold by the forest of tall smooth corn-stalks. Here are many well-known weeds. The all-too-common Chickweed, *Stellaria media,* is at home, and the Field Scorpion-grass, *Myosotis arvensis,* with hairy leaves and tiny blue flowers; the Black Bindweed, *Polygonum Convolvulus,* twines up the stems of the corn; the Field Pansy raises its little blue and yellow flowers beside the ferny leaves and small pink flowers of the Hemlock Stork's-bill, *Erodium cicutarium,* whose acquaintance we made in a previous chapter (p. 144). Here is a pretty plant that is not so familiar. Its stem branches at the base into several short spreading shoots, which bear delicate leaves divided into hair-like segments, and simple umbels of small white flowers. The fruit is the remarkable feature of the plant, for it has a straight beak, like the bill of a snipe, a couple of inches long. From the appearance of the clusters of these fruits, with their beaks all standing erect, the species derives its English and its Latin specific name—**Venus's-comb, Scandix Pecten-Veneris**. By its much-divided leaves, umbels of small flowers, and by the structure of the fruit, which consists of two flattened carpels adhering by their face to a central axis, we recognise a member of the *Umbelliferæ;* but no other British Umbellifer has got such remarkable fruit-beaks. They remind us of those of the Crane's-bills and Stork's-bills, which we met in a previous chapter (pp. 141–145), but differ in structure, inasmuch as they are formed by the lengthening of the upper part of the inferior ovary after flowering, while in the Crane's-bills the ovary is superior, and the carpels are enclosed by the persistent calyx. In both, however, the point of attachment to the central axis is at the upper extremity, and each carpel separates from below upwards till it hangs from the apex of the beak. Here again similarity ceases, for the Venus's-comb has no apparatus by which the seed is forcibly discharged from the carpel; but instead, the edges of the beak are fringed with teeth, which no doubt aid the dispersal of the ripe fruit.

Beside the Venus's-comb we perceive another small plant that is unfamiliar—a slender and inconspicuous little stranger, that might be easily overlooked. Its stem rises erect for six inches, bearing two or three opposite pairs of delicate leaves, the lower ones stalked and obovate, the upper ones sessile and tapering, with one or two pairs of sharp teeth at the base. Near the summit the stem divides into two widely-divergent branches, which branch similarly again and again. The flowers are very small, pink in colour, borne in little terminal clusters and also singly in the forks of the upper branches. By its corolla seated upon the ovary (*epigynous*), and stamens springing from the tube of the corolla (*epipetalous*), we assign it to the division *Corollifloræ* of dicotyledonous plants; by its opposite leaves, three stamens, and fruit of which only one cell is perfect, and contains one seed, we refer it to the Order *Valerianaceæ*. The presence of an irregular herbaceous calyx-limb crowning the fruit agrees with the genus *Valerianella*, and from the form of the fruit, which has on one side an almond-shaped depression edged on each side by a rib (the ribs being all that remain of the two barren cells), and the small irregular calyx-crown, we correctly refer the plant to *V. dentata*, the Toothed Corn-Salad. The above diagnosis shows how we must proceed in determining an unknown plant. By careful examination and consultation of our text-book, we find what division it belongs to, then what Order it agrees with, and so narrow it down till we reach the species. Then it is advisable to compare our specimen with *all* the specific characters which our text-book gives, to make sure that it agrees in every particular; for in this narrowing-down process a slight slip will lead us far astray, especially if a "key" of any kind be used. In many cases, of course, we may be able to take a short cut, for the appearance of a plant will often suggest the Order, or even the genus, to which it belongs; for instance, if we know one or two of the British St. John's-worts, or Crane's-bills, or Speedwells, we shall probably recognise without difficulty any other member of the genus.

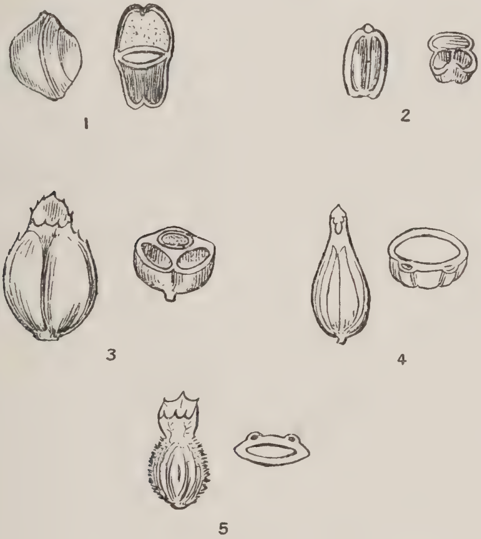

FIG. 58.—FRUITS OF BRITISH CORN-SALADS.

1, *Valerianella olitoria;* 2, *V. carinata;* 3, *V. rimosa;* 4, *V. dentata;* 5, *V. eriocarpa.* Enlarged.

Of **Valerianella** five species are found in the British Isles. They grow chiefly on light cultivated land, and are frequently introduced with seed; two of the five, indeed, have no claim to be considered native. All closely resemble each other, and many mistakes in identity have consequently been made. They are distinguished by characters in the curious half-abortive fruit, and the determination of the species in this genus is an excellent exercise for the student of systematic botany. To identify a *Valerianella* we collect fruiting specimens, and study both the outward appearance of the fruit, and the appearance of its three cells when the fruit is cut across. **V. olitoria, Lamb's-Lettuce**, the commonest species, growing on dry fields, wastes, and walls, has a fruit with two barren cells and a fertile cell which is corky on the back. There is no persistent calyx-limb crowning the fruit. The flowers are pale blue, borne in dense terminal cymes, and the upper leaves have no prominent teeth at the base. **V. carinata** has a fruit with three nearly equal cells; two of them are barren, and owing to their being not distended like the fertile one, there is a concavity on this side, and the fruit is shaped like a boat. The calyx-limb is absent in fruit. The inflorescence and leaves resemble *V. olitoria*. In **V. rimosa** (= *V. Auricula*) the two barren cells are inflated and larger than the fertile one; the fruit is subglobose, and is crowned with the irregular calyx-limb, consisting of one large tooth and two small ones. The lilac flowers are not crowded together in terminal heads, but are borne in the forks of a repeatedly-forked cyme: the upper leaves are generally toothed at the base. This is the largest species; it is about a foot in height.

V. dentata has, as already remarked, the two barren cells of the fruit reduced to a pair of ribs inclosing a flat sunk space; on the other side it is convex: the calyx-limb persists as a small, irregular, four-toothed crown. The flowers and leaves are very like those of *V. rimosa*. Lastly, there is **V. eriocarpa**, the rarest of the genus; it comes near *V. dentata*, but the calyx which crowns the fruit is large, nearly regular, open, and net-veined. The other British genera of *Valerianaceæ* are two in number, and are readily identified. **Centranthus** has a one-celled fruit crowned with a feathery pappus (the altered calyx-limb), and the corolla-tube has a spur on one side. **C. ruber**, the **Red Valerian**, is naturalised on old walls and rocks, and is a well-known garden plant. The genus **Valeriana** is characterised by its one-celled fruit, crowned with a feathery pappus, and corolla without a spur. **V. officinalis**, the **Common Valerian**, is a familiar wild-flower. It has pinnate leaves, the upper ones borne in opposite pairs on the tall stems, which give off a few pairs of short branches above, and bear terminal, dense, flat heads of small, pink, fragrant flowers. The form *V. Mikanii* is distinguished from the form *V. sambucifolia*, which is commoner, by having the leaflets narrower and not toothed. **V. dioica**, the only other British species, is a small plant with ovate undivided root-leaves and pinnatifid stem-leaves. The inflorescence is like that of the previous species. **V. pyrenaica**, a plant of France and Spain, sometimes found in this country in wild-looking situations, is a large bushy herb with heart-shaped toothed leaves, the uppermost with one or two pairs of basal leaflets.

Amid the undergrowth are two little plants with the trifoliate leaves and pea-like flowers that we associate with the **Leguminosæ.** There is no Order of British plants which is more easily recognised than this. The flower, with its large upper petal or standard, two equal lateral petals, and two lower ones forming a boat-shaped keel, is unlike that found in any other race of plants, and in the seventy or eighty species usually included in the British flora there is very little variation in its shape. The leaves, too, are almost invariably either ternate, as in the Trefoils, or pinnate, as in the Vetches; the only exceptions are *Ulex* (Gorse) and *Genista*, and these are indeed only partial exceptions, for seedlings of Ulex have ternate leaves, and many foreign species of *Genista* have the same. Some instructive **leaf-modifications** occur among the British members of this Order. Note the leaves of the Gorse, modified into sharp spines; the transformation may be seen beautifully in seedling plants, the first leaves of which are ternate, resembling those of the Broom, but they quickly change to spines as the seedling grows, so that eventually all the branches end in spines, and bear nothing but spine-leaves; the stipules, which are present in most plants of the Order, and are often leafy and conspicuous, take the form of ovate scales at the base of the spine-leaves. What an efficient armour against browsing animals the Gorse possesses in its spiny foliage, "all

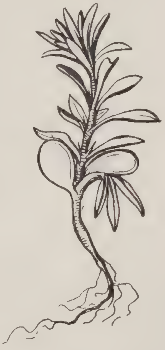

FIG. 59.—SEEDLING OF FURZE, *Ulex europæus*, showing oblong seed-leaves, trifoliate lower leaves, and flat lanceolate leaves, turning into spine-leaves. Natural size.

horrent with projecting spears," has already been pointed out (p. 88). The Clovers, Medicks, Melilots, Bird's-foot Trefoils, and a few others, have ternate leaves. The Vetches, Vetchlings, Lady's-fingers, Milk-Vetches, Sainfoin, &c., have pinnate leaves. In the Milk-Vetches, Sainfoin, and others, the midrib bears a terminal leaflet; in the Vetches this is modified into a tendril, more or less branched, which usually twines round neighbouring objects and anchors the plant. The Vetchlings, *Lathyrus*, have similar leaves, but usually with only one or two pairs of pinnæ; the petiole and stem are in some species winged, with a leafy membrane running down each side. The British species of *Vicia* and *Lathyrus* have already been described (pp. 103–106). Two plants of the latter genus, however, deserve renewed consideration. In *L. Aphaca*, the Yellow Vetchling, as we have seen, the leaf-blade is reduced to a single slender tendril, and the vital functions usually performed by the leaf-blade are here carried on by the stipules, which are enlarged so as to form a pair of broad triangular false leaves, quite as large as one would expect the leaves of such a plant to be (see Fig. 28, p. 105). It is important to note that the first leaves of a seedling of this species are composed of a pair of pinnæ subtended by a pair of large stipules, like those of several other members of the genus; this gives us the clue to how this peculiar arrangement has arisen. The other noteworthy plant is *L. Nissolia*, an inhabitant of rough grassy places. The leaves of this have assumed a grass-like form, by the suppression of the leaflets and broadening of the petiole. They are thus rendered less conspicuous, and therefore less likely to be eaten by herbivorous animals—an evasive rather than a protective device. It should be noted that many of these Vetches and Vetchlings grow in hedges and bushy places, where their sweet and juicy foliage gets a considerable amount of protection from the surrounding shrubs; *L. Nissolia*, which prefers more open situations, escapes by mimicking the plants among which it flourishes. But it may be argued, if this is a useful protective appliance, why have not other plants adopted it too? Close beside the narrow-leaved *L. Nissolia* grows the sweet broad-leaved Bush Vetch, quite unprotected, and yet it is more abundant than the plant which has taken such trouble to conceal itself. Answers to such questions are very difficult. We know so little of the real life of plants, of their complicated relations to their surroundings, and of what is advantageous and what disadvantageous to them. If we see that a certain modification assists a plant in the struggle for existence, that at least is a point of positive evidence; if we fail to see what a plant benefits by another modification, may not that be merely the gauge of our own ignorance?

Thanks to the grand work of Darwin and many others, we have perhaps gained the threshold of living plant-lore; but questions innumerable still remain to be solved, and rather than give utterance to the dictum that any plant-structure is useless, or any modification of stem or leaf or blossom unserviceable, is it not better to say we do not understand; and to believe with Kerner that "the position, direction, and shape of the leaf is of just as great significance for the preservation of the species as the form, colour, and smell of the flower; and that no hair is meaningless, whether found on the cotyledon or the leaf, on the stem or the blossom."[1]

The two little plants that are responsible for this digression meanwhile await our examination. Both have trifoliate leaves and small stalked heads of yellow flowers. They resemble each other a good deal, but differ greatly in the fruit. One has a short oval pod concealed in each of the brown withered flowers; the other has bare black pods in an oblong head, each coiled into a flat spiral. This distinguishing mark will not only separate our twisted-podded Spotted Medick—for such the latter is—from several Trefoils which much resemble it, but will serve as a useful generic distinction—the **Trefoils**, **Trifolium**, having a persistent corolla and short straight pod; the **Medicks**, **Medicago**, a deciduous corolla and curved pod. But for this marked difference it would be easy to confound several Trefoils—*T. procumbens, T. dubium, T. filiforme*—with the Medicks *M. lupulina, M. denticulata, M. arabica, M. minima.* But it remains to point out the characters by which the closely-similar species of each of these two groups may be distinguished from each other. **Medicago lupulina**, the plant which grows in our field, differs from the other Medicks mentioned in its pods being destitute of spines, and its flowers borne in dense oval heads. The leaves are downy, with obovate leaflets. It is a common species. **M. denticulata** is a nearly glabrous plant, with obcordate leaflets, and stipules cut into many acute points, clusters of few (one to five) small flowers, and flat pods which are deeply pock-marked, furnished with a double row of spines, and coiled into a close spiral of two or three turns (Fig. 60). It grows in sandy ground near the sea, and is rare. **M. arabica** (=*maculata*) is of rather more frequent occurrence, though, like the last, absent from Scotland and only a waif of cultivation or commerce in Ireland. It is distinguished by its half-cordate toothed stipules, and curious pod coiled into a globose spiral of two to five turns, with a row of curved spines along each side, and four ridges on the margin; the inflorescence and foliage resemble that of the last, but the leaves are larger, and each leaflet usually bears a dark spot. **M. minima** is a very rare species found in the east of England. It is a little downy plant, with few-flowered heads, stipules as in *M. arabica*, and pods compactly coiled in four or five turns into a globose prickly ball; the pod is smooth, with a thin edge, and a double row of hooked spines.

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[1] "Flowers and their Unbidden Guests," p. 6.

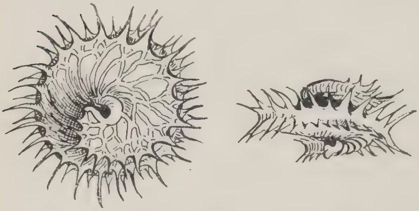

Fig. 60.- Fruit of Reticulated Medick, *Medicago denticulata.* × 3.

The foregoing species are annuals, *M. lupulina* alone sometimes persisting for a second year. The remaining British Medicks are taller and perennial, with larger flowers, and pods destitute of spines. **M. sativa**, the **Lucerne**, is a fodder plant, often run wild. It is easily known by its upright stems one to two feet high, many-flowered racemes of purple blossoms, and pods twisted into a loose, open spiral like a corkscrew. **M. sylvestris** is similar, but more slender, with greenish or purplish flowers, and pods bent into a simple flat ring. It is very rare, but occurs in England, Scotland, and Ireland, and by many authorities is considered a hybrid between *M. sativa* and *M. falcata*, or a variety of the latter. **M. falcata** has yellow flowers, and pods that are not spiral, but only slightly curved. The coiled spiny pods of certain Medicks above described are among the most curious fruits to be found among British plants, and differ widely from those of any other genus of *Leguminosæ*.

To turn to the Trefoils. Three yellow-flowered species are liable to be confounded with the Medicks and with each other. From the Medicks, as stated above, they may be separated by their short straight pod enveloped in the withered persistent corolla. The little plant which grows in our cornfield is **Trifolium dubium** (= *minus*), distinguished by its heads of about twelve flowers, and the upper petal or standard being folded and truncate. This is the plant which is generally held to be the **Shamrock** in Ireland, though the claims of *T. repens* are almost equally strong, as has been shown by the careful inquiry recently carried out by Mr. Colgan.[1] *T. dubium* is universally distributed over the British Isles. **T. filiforme** is very like the last, but is a more slender plant, and the tiny flowers are in loose clusters of two to six, each distinctly stalked. It grows in dry pastures and lawns. **T. procumbens** is larger and stouter than *T. dubium*, and can generally be recognised at sight by its large dense oval heads of about forty flowers. A doubtful specimen can be identified by the shape of the standard, which is broad and not folded over the pods, as in the two preceding species. Eighteen species of *Trifolium* are ranked as native British plants, and several others are found half wild, waifs which have been imported with Grass and Clover seed. The more common species have been described already (pp. 146–149).

But before resuming our search among the low herbage which the corn shelters, mention must be made of a peculiar feature relating to the roots of the Trefoils and other Leguminous plants. If we wash the roots of a Clover or Medick clean, we shall find that they bear numerous little egg-shaped swellings or **tubercles**. The origin and function of these tubercles have been the subject of careful investigation by botanists, who have published the interesting results they obtained in various scientific periodicals—the papers most easily accessible to English readers being those of

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[1] *Irish Naturalist*, vol. ii. p. 207 (1893).

Professor Marshall Ward,[1] who took a foremost part in the inquiry. It would appear that these tubercles are the result of the stimulation caused by the presence of certain bacterial organisms, which make their way into the tissue of the root, and there multiply like internal parasites. The root swells at the point where the bacteria establish themselves, and eventually encloses them in a corky envelope. These bacteria are very lowly plants, consisting of rod-like rows or chains of cells; they are the smallest known forms of vegetable life. They grow by the continued dividing of the cells; in reproduction they exhibit no sexual process, but spores (cells which become free and are capable of developing into a new organism) are produced inside the cells, or the cells themselves separate and act as spores. With the vast importance of these microscopic plants in their relation to the processes of fermentation, and putrefaction, and disease, we are not at present concerned: but one function of the bacterium found in the tubercles of Leguminous plants—*Rhizobium*, as it has been called—must be specially noted. There appears to be little doubt that this organism is able to assimilate the element nitrogen directly. Now, although nitrogen is an essential constituent of protoplasm—that substance which is so intimately connected with every display of vital activity—and of other complicated nitrogenous substances (*proteids*), most plants, and among them the *Leguminosæ*, are unable to assimilate it from the atmosphere, though this gas is present there in a large proportion. But the bacteria in the tubercles of Leguminous plants absorb free nitrogen, and the flowering plant is able to plunder their store; the latter therefore gains materially by the presence of the bacterium. The *Rhizobium*, in its turn, feeds on the sap and cell-contents of the plant which it infests, and therefore obtains corresponding advantages. These tubercles, then, appear to be the scene of a true **symbiosis**—an association of two separate organisms which live in intimate connection for their common benefit. "Though the symbiosis is useful to both," says Professor Ward,[2] "the plant gains most, for it is the more powerful, and sooner or later overcomes the bacteria, to the multiplication of which it sets limits, and finally absorbs the substance of the latter. Being the stronger, the plant directs the symbiosis. It encloses the bacteria . . . by means of cork, and also protects them. . . . Between the bacteroid tissue and the cork it provides vascular bundles (1) to feed the bacteria and convey the carbohydrates necessary to produce proteids, and (2) to take up the dissolved substance of the bacteroids as required." An important point is that, if Leguminous plants are grown in earth in which bacteria have been destroyed by baking, the tubercles are not produced; but the plants do not appear to suffer from the absence of their little companions. They can be easily infected by the tubercle-bearing root of another plant grown under ordinary conditions, and then the characteristic swellings appear. Whether the bacteria also can maintain an existence independent of the rootlets does not seem to have been yet made clear.

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[1] *Philosophical Transactions*, vol. clxxviii. B. (1887); and *Proceedings of the Royal Society of London*, vol. xlvi. (1890).

[2] *Proceedings of the Royal Society*, vol. xli. pp. 441, 442.

One of the prettiest plants of the low jungle of cornfield weeds is the **Fumitory, Fumaria.** The stem is succulent and straggling, the leaves delicately fragile and daintily divided in a bipinnate or tripinnate manner. The petioles, though not modified into tendrils, act the same part, frequently coiling round adjacent stems and helping to support the plant. The flowers are pink, tipped with purple, irregular, and curiously formed; they are borne in racemes. Each flower has two sepals, rather heart-shaped, toothed, soon falling off. They vary in size in different species, being sometimes coloured like the corolla and conspicuous, sometimes reduced to small green scales. The corolla is long and narrow, consisting of four petals. The upper one is prolonged backwards into a spur, the two inner ones are joined together at the tip. There are apparently six stamens, arranged in two bundles, and a one-celled ovary which develops into a little globular fruit. **Fumaria** is a difficult genus, the several kinds being puzzlingly similar. The British forms have been variously divided into one to eight species, according to the conception of botanists of the value of the differences which distinguish them. Several of the forms are common weeds in cultivated land. The Order *Fumariaceæ* contains but one other British genus—**Corydalis,** now called **Neckeria,** the latter being the older name, and therefore entitled to priority. *Neckeria* differs from *Fumaria* in its fruit, which is a pod. Only one species is native in Britain—**N. claviculata**, a slender and most graceful little plant, like a yellow-flowered *Fumaria*, growing in dry bushy places. The delicate leaves end in branched tendrils, by which the plant climbs towards the light and air (see pp. 96, 97). **N. lutea** is a stouter, succulent, bushy plant, with showy yellow flowers, which is naturalised on old walls. **N. solida,** occasionally found in old shrubberies, has large purple flowers and a solid rounded tuberous root-stock.

Rising erect almost as tall as the corn are the stems of the Marsh Woundwort, *Stachys palustris.* The specific name is not altogether descriptive of the habitat of this plant, which, though often growing in marshy places, is equally at home in cultivated fields. This is a member of the important Order **Labiatæ,** so called from the two-lipped flowers. The corolla-tube is usually long; the upper lip in which it terminates is entire or bifid, the lower trifid. The flowers are much of the same shape as those of some of the *Scrophularineæ,* such as *Euphrasia, Bartsia, Pedicularis, Rhinanthus;* from these any member of the *Labiatæ* may be distinguished by its ovary, which is four-lobed, as in *Boragineæ,* each lobe with one ovule, and ripening into a nut; while in *Scrophularineæ* the ovary is two-celled, ripening into a two-celled capsule containing many seeds. The Labiates have all square stems and leaves in opposite pairs, and are almost always fragrant and aromatic. They form a large and important Order, numbering, according to Hooker's "Handbook," 2600 species. Many of the best-known kitchen herbs are Labiate plants—Thyme, the Mints, Sage, Marjoram, Basil, Balm, &c., also the sweet-scented Lavender and the Rosemary. The **Woundworts,** however, are not fragrant; when crushed they emit a strong unpleasant odour. They are coarse hairy herbs. From allied genera they are known by having the two inferior stamens longest, the calyx five-toothed, bell-shaped, and the anther-cells bursting longitudinally. **Stachys palustris** has a far-creeping rhizome which sends up unbranched stems bearing opposite pairs of nearly sessile lanceolate leaves, subcordate at the base, pointed at the tip. The flowers form a long spike-like inflorescence, and are borne in the axils of the upper leaves in false whorls, as has been described in the Purple Loosestrife (p. 164), and they are dull purple in colour. **S. sylvatica**, a common plant in woods and copses, has a general resemblance to the last, but is easily separated by its long-stalked cordate-ovate acute leaves. **S. arvensis** is a little cornfield annual, with cordate-ovate blunt leaves and small pinkish flowers. All the above are widely distributed in our islands. **S. germanica** grows only in a few English counties. It is rendered easily recognisable by its woolly stem and densely-silky leaves, which give the whole plant a uniform grey colour. **S. Betonica**, which is common in England, but rare in Scotland and Ireland, grows in woods and copses. The leaves are egg-shaped, cordate at the base; the inflorescence is different from that of the others, consisting of a short dense terminal spike. Plants intermediate in character between *S. palustris* and *S. sylvatica* are frequently found. These are hybrids, produced by the crossing of the two species. The offspring of this union partake sometimes more of the characters of one parent, sometimes of the other. Like most hybrids, they do not produce perfect seed, and they are usually found where the parent species grow side by side.

Our time grows short, and many cornfield wild-flowers must be left unexamined. What a wealth of vegetation is found on these light soils! Look at this field—

"Rank
With what the dull incurious *weeds* account,"

as Thomson says. What is a weed, after all, but a wild-flower in the wrong place?—the wrong place, that is, from the husbandman's point of view; for he sowed here nothing but corn, and yet we might collect half a hundred species from among the crop—

"Harlocks, hemlocks, nettles, cuckoo-flowers,
Darnel, and all the idle weeds that grow."
—*King Lear.*

These are mostly annual plants, whose seeds are scattered before the harvest is garnered, and which spring up afresh every year. Numbers of other seeds arrive during the autumn, borne on wings from neighbouring colonies. Other weeds have long tough roots, or succulent rhizomes, of which even a scrap will grow and form a new plant. Thus these weeds do battle with the husbandman. They love the freshly-turned soil enriched by manures, and he cannot drive them out. Indeed, a number of them appear to be now confined to cultivated fields and the neighbourhood of the abodes of man. Where cultivation ceases, they are speedily elbowed out and choked off by stronger invaders. A sandy field is allowed to lie fallow. The first summer it blazes with scarlet Poppies and yellow Charlock; Goosefoots and Oraches raise their tall pyramids of foliage, and Dead-Nettles, Violets, Chickweed, and many other smaller plants grow exuberantly. Next year the perennial plants which have secured a footing obtain a start, and crush out many of the annual species; by the third or fourth year all the soft annuals are gone, and the ground is occupied by Nettles and Field-Thistles, Ox-eye Daisies and Couch-grass, and other strong perennials, and among them some biennial species which are able to force their way among the crowd, such as Burdocks.[1]

How then do these annual plants of cultivated ground exist where there is no husbandry to deliver them from their stronger brethren? Near the sea, among shifting sands, and on barren gravelly wastes where their enemies cannot maintain an existence, on the banks which summer droughts leave bare along the edges and in the beds of rivers, they find a refuge. But many of them have apparently become so dependent on the operations of husbandry for a suitable home, that there can be no doubt that if man ceased to till the ground great and striking changes in our flora would result. These are the plants which Watson, in his *Cybele Britannica*, has called **colonists**; a colonist he defines as "a weed of cultivated land or about houses, and seldom found except in places where the ground has been adapted for its production by the operations of man; with some tendency to appear also on the shores, landslips, &c." With less claims to a place in our flora are the **aliens**, plants known to have been introduced from other countries, such as the Canadian Weed, and the Yellow Mimulus, and the Dame's Violet, though some of them are now, to all appearance, as thoroughly at home in our islands as the most ancient of our native plants. The **denizens**, as defined by Watson, are plants at present maintaining their habitats without the aid of man, but liable to some suspicion as having been originally introduced—such are the Sweet Violet and the Touch-me-not; while in a fourth division he places the truly native species, which, from their distribution and habitat, we believe to be aboriginal plants—plants which have been "always" here, so far as our brief human history is concerned. Regarding the origin of these, some few remarks were made in a former chapter (pp. 126–132).

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[1] For a very interesting account of the annual changes in the flora of a piece of waste ground at Aberdeen, see Professor Traill in *Annals of Scottish Natural History*, October 1896 and January 1897.

SCENE X

IN THE HOME OF THE ALPINES

(Head of Deepdale, Westmorland, *August* 1895.)

Here, by this great boulder, we may pause and look around and take welcome rest. Behind us towers the mountain, first in a steep rocky slope, climbing step upon step, then as a huge beetling cliff which towers dark and menacing, disappearing at length into a grey veil of hurrying vapour. The wind shrieks along its buttresses, tossing the gnarled branches of stunted bushes of Mountain-Ash, and breaking the silvery threads of water that trickle down its face into shimmering rain.

In front what a view extends! The ground drops in several broad terraces, each hundreds of feet lower than the last, and far beyond the lowest of them comes the glint of a stream, and the sides close in to form a deep dark glen, which stretches for several miles to open out on the wider valley that drops from Kirkstone to Brothers' Water, and thence to Patterdale and Ullswater. Beyond the fields and trees of this sheltered vale all is bare mountain again, stretching ridge upon ridge to the distant sky-line. The eye wanders with delight over the wide expanse of heaving brown hills and high rocky ridges, and for hours we could lie here in the shelter and watch the march of the cloud-shadows over hill and dale, and listen to the bleating of the sheep and the faint murmur of the water that the wind brings up from the valley far below. Our attention as botanists is caught by the details of the foreground. Look at this huge rock-fragment which affords us grateful shelter from the keen wind. At some bygone time it has crashed down from the cliff above, loosened by frost and rain, tearing up the ground as it came, to subside here in a cloud of dust, its destructive course completed. Now it is decked with patches of grey and yellow lichen and seams of dark-green moss, and round its base the Parsley Fern forms a verdant trimming. The ground about it slopes upward towards the cliff. How dwarfed and stunted the vegetation is! That is caused by the exposure of the place, for we are over 2000 feet above the sea, and every sighing zephyr of the valley is here a keen and whistling wind. If we ascend the course of this little rill which leaps downward from stone to stone, we shall soon find some of the wild-flowers that haunt these exposed inhospitable steeps. Here is a bright mat of a little plant with leafy shoots and starry yellow flowers. The leaves are sessile and strap-shaped, the petals dotted with red. It is one of that genus of mountain plants, the **Saxifrages**, and its name is **Saxifraga aizoides.** Note the five sepals, five spreading petals, ten stamens forming a wide-spreading ring, and the ovary with two spreading stigmas. The fruit is egg-shaped, with two diverging horns. The ring of prominent stamens and the two-beaked fruit will usually serve as satisfactory distinguishing marks in this genus. The Saxifrages are a beautiful race of plants, and are essentially characteristic of the mountain flora. Most of them are tufted perennials, forming verdant carpets by rills, or clinging in close cushions to the bare rocks. The number of species in the British Isles is variously accounted from twelve to eighteen, according to the treatment of certain puzzling forms which connect species in themselves sufficiently distinct. The two largest British Saxifrages are confined to Ireland—**S. umbrosa, St. Patrick's Cabbage** or **London Pride**, and **S. Geum.** The former occurs along the west and south coasts, the latter in Cork and Kerry, and both haunt the neighbourhood of the mountains. Both have panicled

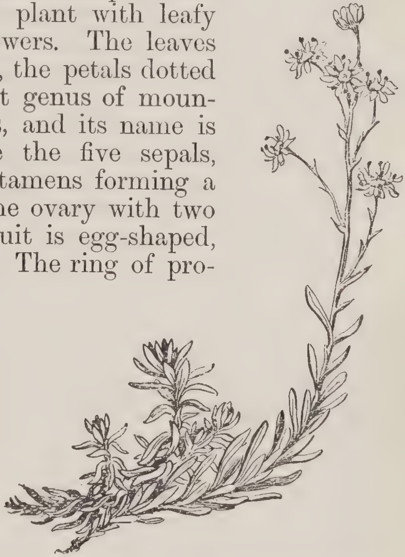

FIG. 61.—YELLOW MOUNTAIN SAXIFRAGE
Saxifraga aizoides. Half natural size.

cymes of small white flowers on a leafless scape; the stamens are red and conspicuous, and the petals dotted with red. *S. umbrosa* has coarsely-toothed obovate leaves, which narrow gradually into stout flattened petioles. In *S. Geum* the leaves are orbicular with a deeply cordate base, less toothed than the last, and borne on slender petioles; between these two, several intermediate forms exist. **S. stellaris** is a small plant found by alpine rills. It grows here in Deepdale, and from where we stand we can detect its close green leaf-rosettes and starry white blossoms on a wet rock a little farther up the slope. Its almost sessile oblong wedge-shaped leaves and tapering filaments distinguish it from its congeners. **S. Hirculus** is a rare species inhabiting wet bogs. It is the only British Saxifrage besides *S. aizoides* that has yellow flowers. It is well marked by its unbranched leafy stem bearing one or two large blossoms, the petals much dotted with red. **S. hypnoides** will serve as a representative of the most puzzling group of the Saxifrages. It is a mossy little plant, growing in loose cushions, with prostrate barren shoots, bearing leaves that are undivided or three-cleft, and close rosettes of three- or five-cleft leaves, from which rise slender stems, branched near the top, each branch bearing a white flower. A number of closely-allied forms exist, which are difficult of discrimination. In Hooker's "Handbook" we find them all grouped under one aggregate species, *S. hypnoides;* in the "London Catalogue" they appear as six species—*cæspitosa*, *Sternbergii*, *decipiens*, *grœnlandica*, *hirta*, and *hypnoides*. The differences between them are found chiefly in the length of the barren shoots, the closeness of the tufts, and the shape of the leaves and sepals. But from *S. hypnoides*, with its loose straggling cushions, long shoots, acute leaves and sepals, and branched stem bearing large flowers, to *S. cæspitosa*, which grows in dense tufts composed of close rosettes, with very short shoots, blunt leaves and sepals, and compact cluster of small flowers, every gradation exists. They are all mountain plants, and the range of several of the forms is very limited.

The other British Saxifrages offer no difficulty. **S. tridactylites** is a little annual species, delighting in old walls and dry banks. It grows erect, with five-cleft root-leaves, and a branching stem bearing extremely small white flowers. Each peduncle is subtended by two small bracts. The whole plant is hairy and sticky, and is more or less tinged with red. **S. granulata**, the Meadow Saxifrage, is easily recognised by the numerous small bulbs borne on the roots. For the rest, it grows six to twelve inches high, with reniform root-leaves and lobed stem-leaves, and large white flowers. It haunts dry banks, and is widely distributed. **S. cernua**, **S. rivularis**, and **S. nivalis** are small and very rare alpine plants. *S. cernua* is known by its roundish five-lobed cordate leaves, and leafy stem bearing red axillary bulbils and one or two small drooping white flowers. It is found only on the summit of Ben Lawers, in Perthshire, at an altitude of 4000 feet. *S. rivularis* grows sparingly on mountains in Scotland. It has decumbent rooting stems, palmate five-lobed leaves, the stem-leaves less divided, and small white flowers. *S. nivalis* has its head-quarters in Scotland, but extends to the Lake District, Wales, and Sligo. It resembles *S. stellaris*, having a rosette of short toothed leaves and leafless scapes; but it has no barren shoots at the base, and the flowers are crowded together into a head. Lastly comes **S. oppositifolia**, very different from any of the other native Saxifrages. It is a tiny creeping plant, with leaves in four dense rows and purple flowers. It forms a close mat on damp rocks on most of our mountain groups.

Close by, growing in a clump of dripping moss overhanging the rill, we find another plant that is characteristically alpine in its distribution—**Thalictrum alpinum**, the **Alpine Meadow-Rue** (Fig. 62). A tiny species this, with pretty biternate leaves—that is, the leaf-stem splits into three branches, each of which bears three leaflets. It will be remembered that reference was made to the Meadow-Rues in a former chapter (p. 50): this is much the smallest of the genus, its flower-stems being only a few inches high. The flowers are borne in a simple raceme. Like those of the other species, each has four small sepals, no petals, and a conspicuous cluster of yellow stamens.

Another plant of the mountains is here, growing abundantly over the rocky slope. This is the **Alpine Lady's-mantle, Alchemilla alpina**, one of the daintiest of our wild-flowers. The stem is short and creeping, clothed with brown scales. The leaves consist of five to seven oblong leaflets springing from one point like the fingers of a hand. They are dark green above, beautifully silky below. The flowers are clustered on a branched stem. They are minute, and green in colour. Note their structure, for they look very different from those of Roses and Brambles, Cherries and Cinquefoils, and we might not suspect that they belonged to the same Order—*Rosaceæ*. The calyx is rather bell-shaped below, spreading above into four lobes, with the four narrower lobes of an outer calyx formed of bracts (epicalyx) appearing between them. There is no corolla. The four stamens are seated on the mouth of the calyx-tube, which is all but closed by a thickened ring. The style springs not from the top of the ovary, as usual, but nearly from its base. The flowers of the three other British

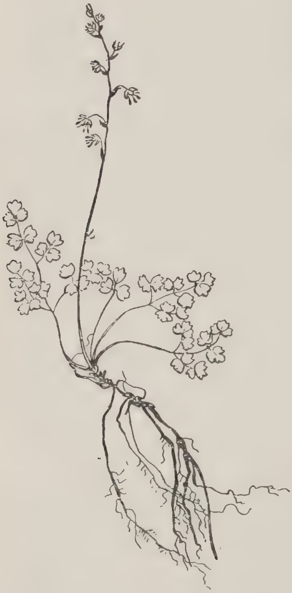

FIG. 62.—ALPINE MEADOW-RUE, *Thalictrum alpinum.* Half natural size.

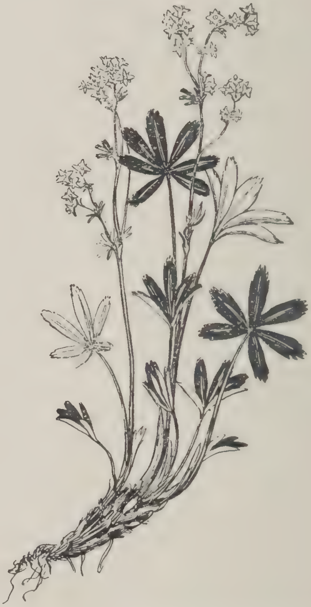

FIG. 63.—ALPINE LADY'S-MANTLE, *Alchemilla alpina.* Half natural size.

Lady's-mantles are similar, though the plants vary in general appearance. **A. vulgaris, Common Lady's-mantle**, grows in pastures and meadows. It is the largest of the genus, being about a foot high. The leaves are reniform, five- to seven-lobed, and plaited like a fan, bright green on both sides. **A. argentea** (= *conjuncta*) is an extremely rare species resembling *A. alpina;* it differs in its leaves, which are not split quite to the base into separate leaflets, and which grow so that the two external lobes touch each other, the lobes radiating from the petiole in every direction, and presenting the appearance of a peltate leaf. It has been found in Forfar and Arran. **A. arvensis** is a small annual, with branched leafy stems. The leaves are fan-shaped, deeply cut and lobed, almost sessile. Large green stipules, palmately divided, are present. The tiny green flowers grow in sessile clusters. The epicalyx is rudimentary. It is very common on banks and cultivated land. *Alchemilla* differs from most genera of *Rosaceæ* in its four-parted calyx, the presence of an epicalyx, absence of corolla, and small definite number of stamens.

Another alpine plant that grows here, forming close cushions on the drier slopes, is the **Moss Campion** or Cushion Pink, **Silene acaulis**, the smallest of the Catchflies. Some of its near allies we have met with in a previous ramble (pp. 186–188). This species is unlike any of them. It presents a dense surface of tiny, narrow, undivided leaves; its cushion-like habit is the result of the continual branching of the slow-growing stems. The flowers are borne singly on short peduncles, and are large and bright pink, so that a boss of this plant in full bloom is a beautiful and brilliant sight. We are too late to find flowers, but the fruit-capsules still stand erect, gaping and empty.

So much for the plants of the rock-strewn slope. Let us now ascend this gully, where a stream comes leaping down from the heights above, and search for further mountain flowers. One bold showy plant, growing on a grassy ledge, catches our eye from afar, and we reach it with the assistance of the gnarled and twisted trunk of a Holly, which furnishes a secure foothold. This is the **Narrow-leaved Willow-herb**, or Flowering Willow, **Epilobium angustifolium.** It is a noble plant, with tall leafy stems four or five feet high, and a long raceme of large rose-coloured flowers. From the resemblance of the leafy stem to the young shoot of a Willow, the English names of the plant are derived; the long, narrow, tapering leaves are not unlike those of the Osier, *Salix viminalis.* Note the long narrow ovary, which, being inferior, gives the flower the appearance of being long-stalked; it is in reality nearly sessile. The petals are four in number, the lower two shorter and narrower than the others. There are eight stamens; the style is long and slender, terminating in four stigmas which spread like a cross. The ovary matures into a long, narrow, pod-like capsule, which eventually splits from the apex into four recurving valves, emitting the seeds, which are spindle-shaped and crowned with a tuft of silky hairs, like the fruits of certain *Compositæ* of the genera *Sonchus, Senecio, Centaurea, Crepis,* &c. Indeed, this resemblance is striking, when we remember how differently the two arise. In the *Compositæ* the fruit consists of the one-celled and one-seeded ovary, surrounded by the adhering calyx, which expands above into the pappus. In *Epilobium* it is each mature seed of the many-seeded ovary that looks so like the *achene* of the *Compositæ,* and the pappus is a development from the testa or coat of the seed. The purpose served by the crown of hairs is in each case the same—to promote dispersal by the wind; and no doubt a spindle-shaped seed is the most convenient form of "car" for balloons of this description. The *irregular* flowers and abundant *alternate* leaves will distinguish *E. angustifolium* from the other members of the genus. These are somewhat numerous, numbering eleven species, and several of them are common wild-flowers. **E. hirsutum** is a fine plant which grows in wet places, with hairy sessile opposite leaves, stems branching above, and large rose-coloured flowers. It is well marked by its numerous, leafless, underground shoots, which rise into fresh stems or *suckers.* **E. parviflorum** is equally common in damp places. The stem is usually unbranched, the whole plant downy, the flowers pink and very small, the stigma four-cleft. **E. montanum**, the **Broad-leaved Willow-herb**, is familiar as a common weed in gardens. Its leaves are smooth, ovate-lanceolate with a rounded base; the stigma is four-cleft like that of the preceding species. **E. obscurum** grows in wet places. It has sessile, glabrous leaves, tapering from a rounded base, the margins slightly toothed; the stem is four-angled, the stigma club-shaped and undivided. **E. palustre** is common in marshes. Its leaves are narrow and entire, tapering from a wedge-shaped base, the stem round, nodding at the top, the stigma undivided. For descriptions of the remaining species, some of which closely resemble the three last named, a botanical text-book should be consulted. A curious feature of the Willow-herbs is the ease with which the pollen of one species can fertilise the ovule of another. The hybrids thus produced partake of the character of both parents, being sometimes nearer to one, sometimes nearer to the other. In the British list alone, thirty-three hybrids find a place, the result of the crossing of eleven out of our twelve native species. *E. angustifolium* alone appears incapable of fertilisation by pollen other than that of its own species.

Another plant of the lower slopes that appears quite at home in the sheltered nooks which are to be found along the cliff-line is *Geranium sylvaticum*, the Wood Crane's-bill, of which mention has already been made (p. 142). With it grows the **Stone Bramble, Rubus saxatilis,** one of the few members of that complicated genus which the young botanist can hope to name without skilled help. A few of the Brambles—the Raspberry, *R. Idæus*, the Stone Bramble, and the Cloudberry, *R. Chamæmorus*—are plants easily recognised, and of the specific distinctness of which there can be no doubt. But the other British forms —and their name is legion—present a hopelessly-confusing series, merging one into the other in a most bewildering manner. The wise Linnæus gathered them all together under one name, **Rubus fruticosus**, diagnosing the species as "Rubus foliis quinato-digitatis ternatisque caule petiolisque aculeatis"—bramble with five-lobed and ternate leaves and spiny stem and petioles; and under this comprehensive title most beginners, and many more advanced students, will be content to leave the numerous forms that are everywhere to be found; for the Brambles are perhaps the most puzzling of the various critical genera with which systematic botanists have to deal. The continued study of the group by careful workers has led to an enormous increase in the number of forms on which specific names have been bestowed, so that the British list stands at present at about a hundred species and fifty varieties. But the differences which separate these "species" are so slight that years of study alone can enable the student to name his plants with confidence, and even then only such plants as are characteristic, and have been grown under normal conditions of light and soil and situation. The close attention that is now being paid by students of this group to the various forms *in the field* may throw light on the marvellous variability of the group that study of herbarium specimens could never do. For may it not be that here we have the evolution of new plants actually taking place? that an old parent-form is splitting up under influences that we do not fully understand into a number of species? And while the labelling of dried specimens and the inventing of Latin and Greek names for Brambles that differ in spininess, or hairiness, or shape of leaf or panicle from one another may not bring us any nearer to an explanation, the careful study of the living plants, of the details of their fertilisation, their development, their variability under different conditions, may suggest the true significance of the bewildering series of plants that are included under the name *Rubus fruticosus.*

Strikingly distinct from the maze of Blackberry forms are the other British *Rubi.* **R. saxatilis**, which trails over the rocks on our mountain-cliff, is well marked by its very long, slender, prostrate, barren stems, with few weak prickles, and short upright flowering shoots, which bear two or three ternate leaves and a small umbel-like cluster of white blossoms, each of which produces one or two large red drupes, very different from the globular head of many black drupes produced by *R. fruticosus.* This is a mountain plant, but not an alpine. **R. Chamæmorus,** the Cloudberry, is a true alpine, delighting in the cold and exposure of bogs at high elevations. It is a small herbaceous plant, with a creeping rhizome, no long aërial, barren shoots, very short one-flowered stems without prickles, simple lobed leaves, and large orange drupes. The **Raspberry, R. Idæus**, is a familiar plant. From those of the Fruticose *Rubi* that most resemble it, it can be distinguished by its leaves, usually pinnate, with five leaflets, slender prickles, drooping flowers with short petals, red or yellow hoary fruit, and numerous suckers. It is the production of suckers—stems produced at the end of underground shoots—that causes wild Raspberries to grow in dense groves. Blackberries have a different habit which answers the same purpose. In autumn the ends of the long shoots produced during the year bury themselves in the ground, anchor themselves securely by means of numerous root-fibres which they emit, and the point of the shoot turns upwards and develops a bud. Next year the shoot flowers and dies. Meanwhile the terminal bud grows up, fed by the root-fibres, and becomes a separate plant. The illustration (Fig. 64) represents the termination of a bramble-shoot twenty-five feet long, gathered last Christmas-time. Not only was the main stem rooted at the tip, but thirteen secondary branches which it bore were rooted likewise, so that no less than fourteen new plants were formed by the annual growth of a single shoot.

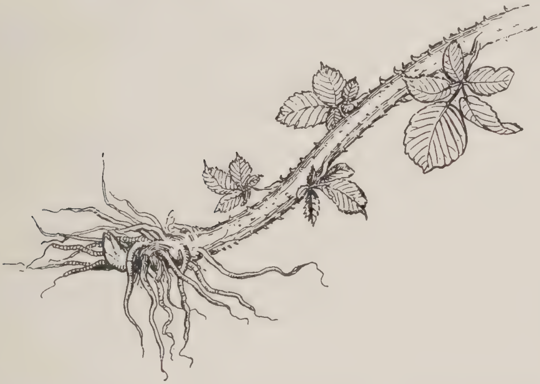

FIG. 64.—ROOTED TIP OF A BRAMBLE SHOOT. One-third natural size.

In the chinks in the rocky walls of the ravine we may find another truly alpine plant, the **Mountain-Sorrel, Oxyria digyna.** It has been mentioned on a previous page, when speaking of the Docks (p. 50). It is easily known by its fleshy kidney-shaped leaves and branched stems bearing whorls of small greenish flowers like those of the Common Sorrel. The stamens are red, which gives a touch of colour to the inflorescence. Along with it grows another alpine, the **Rose-root, Sedum roseum** (=*Rhodiola*). This is a peculiar plant. Note the very thick branched grey root-stock, the result of many years' slow growth. If we break it across, the pink fleshy interior smells deliciously fragrant; from its suggesting the odour of roses, the plant takes its English name. From the apex of the root-stock spring several round fleshy stems half a foot in length; they are thickly clothed with succulent, sessile, glaucous leaves; these are more crowded in the upper part of the stem, and surround the terminal flat cymes of yellow flowers. Each flower has four very small sepals and four narrow petals. The stamens are eight in number, on long spreading filaments like those of the Saxifrages. To find the pistils, we must look at other plants, for the species is diœcious. The female plants have flowers with smaller petals and four carpels. In its four-parted diœcious flowers this plant differs from all the other British Stonecrops. That which most resembles it in appearance is **S. Telephium,** the **Orpine** or Live-long. This species has leafy stems like those of *S. roseum*, but the elongated root-stock is absent, the flowers are purplish-red, with the parts in fives—the stamens being double that number. The other species found in our islands are small plants usually forming mats of leafy barren shoots on rocks and dry places. They may be divided into two groups according to the colour of the flower, some being white, some yellow. Under the former group come **S. villosum**, **S. album, S. dasyphyllum, S. anglicum.** *S. villosum*, found in wet northern mountain pastures, is a biennial, and may be known by the absence of barren rooting shoots. *S. album* is distinguished by its almost cylindrical leaves and glabrous panicle. The flowering stem rises erect half a foot, with leaves much larger than those of the barren shoots. *S. dasyphyllum* is a smaller plant with glaucous leaves shaped like an egg, a procumbent flowering stem, and pubescent panicle. It is naturalised here and there on walls. *S. anglicum* is the commonest white-flowered species, being abundant in most sandy or rocky places. It has a smooth bifid cyme of flowers, and leaves spurred at the base. Of yellow-flowered Stonecrops, **S. acre** is the commonest, abounding in situations similar to those which *S. anglicum* favours. The leaves are solid-egg-shaped, like those of the last, the sepals blunt. **S. sexangulare,** which is not a native, but has run wild here and there, has linear blunt leaves and acute sepals. It derives its name from the leaves being usually arranged in six rows along the stem. The remaining yellow-flowered species are larger plants, with flowering stems half a foot to a foot in height, and acute leaves. **S. reflexum** has cylindrical tapering leaves, those of the flowering shoots reflexed. It is frequently introduced; the variety *albescens*, found in Suffolk and Devon, is alone considered native. **S. rupestre** may be known from the last by its flattened linear-lanceolate leaves, which are much crowded, so that the barren shoots terminate in an oblong mass of overlapping leaves. **S. Forsterianum** is allied to the last. It is more slender, the leaves form "small rose-like tufts," and the inflorescence is more distinctly cymose. It is found on rocks in Wales and the west of England. All these Stonecrops, it will have been observed, are characterised by very **fleshy leaves.** So much is the thickness increased, in many instances, that the leaf is circular in section. The tissue of the leaf is not hard and dry, like that of a twig or spine, but soft and full of water. Both the form of the leaf and its water-store are provisions against drought, to which, owing to the very dry situations in which these plants grow, they are frequently exposed. Of all shapes which the cross-section of a leaf might assume, that of a circle is the one which presents the smallest surface for any given area, so that this form gives the greatest storage-capacity while offering the smallest surface for evaporation. The Stonecrops and other succulent-leaved plants, like the House-Leek, Samphire, Sea-Purslane, &c., as well as numerous foreign species, such as the Aloes, and others like the Cactuses, where the stem instead of the leaf is thickened and forms the reservoir, all store up water during the wet season, and retain it for use during the summer, when the parched ground can no longer supply their roots with moisture. The Cactuses, and many plants of similar habit, have, moreover, a formidable armature of thorns to prevent thirsty animals from browsing on their juicy branches.

Of the British Meadow-Rues and Catchflies mentioned above, it will be noticed that one of each genus has fixed upon mountainous situations as its chosen place of abode; in each case this species is the smallest member of the genus, and this dwarfing of growth may be observed in all truly **alpine plants**. The reasons are not far to seek. Tall plants would be speedily battered to pieces by the wind; and besides, the poor and scanty soil renders economy of material necessary. Our cliff is only partially peopled by members of the alpine flora. *Thalictrum alpinum, Alchemilla alpina, Saxifraga aizoides, S. stellaris, Silene acaulis, Oxyria digyna, Sedum roseum,* these are true alpines, having their head-quarters among the higher mountains, and all are small, compact plants. *Epilobium angustifolium, Geranium sylvaticum,* and the other larger plants which grow here, though quite at home in sheltered nooks among the cliffs, have their head-quarters lower down, and do not range up to the highest crags, as the alpines do; they could not endure the exposure of such situations. Even among the alpines, the larger and more herbaceous species, like the Rose-root and Mountain-Sorrel, do not stray beyond the sheltered gullies and damp crevices of the precipices; only the small compact plants grow fearlessly on the most exposed ledges, defying alike winter frosts and summer droughts, and the storms that up here come at every season. Note how well equipped they are for their wild life. They are all perennials. Winter is long and summer short high up on the mountains. They would have no time to ripen their fruit had they to grow from the seed. Being perennial, they can prepare during the winter for the growth of the coming year, and as soon as the strengthening sun-rays arouse them from their sleep, they are ready to burst into blossom; the flowers are borne on short stems, which are rapidly produced, and do not offer too much surface to the wind. Again, many of these alpine plants grow in carpets or cushions—the Saxifrages, the Gentians, Cushion Pink, and others. Look at this dense boss of *Silene acaulis*—a green, even surface of tiny rigid leaves, closely adpressed to the ground on every side. The root is deep below the centre of the cushion. The dense growth above checks evaporation in summer and restrains the frost in winter. The crowded shoots keep each other warm and moist, and storms cannot harm them.

The size and **brilliancy of alpine flowers** is another interesting point in their history. On the mountains of the British Isles only a sprinkling of alpine plants is found; but in Switzerland, for instance, they abound, forming in the high pastures and slopes glorious sheets of colour, which are a never-failing source of delight to the traveller. But our British flora will provide us with a few excellent examples. Note the size and showiness of the flowers of *Silene acaulis*, *Saxifraga oppositifolia*, *Gentiana verna*, *Dryas octopetala*, compared to the dimensions of the plants that produce them. Furthermore, it has been shown that the colour of flowers at high elevations is more intense than that of the same flowers grown in the valleys.

The reason of these modifications is probably to be found, as Dr. Joly suggests,[1] in the difficulty which alpine plants experience in securing proper fertilisation, on account of the paucity of insect visitors at great heights, and the shortness of the warm portion of the day during which the bees and butterflies can work. This leads to a competition among the plants to secure fertilisation, and the most attractive flowers will have the advantage, will be visited most by insects, and will, in consequence, produce the greatest quantity of seed, so that a race of plants with large and bright flowers will be the result. Mr. Grant Allen has suggested that in the preponderance of butterfly fertilisers over bees at high elevations the key of this question lies, the more æsthetic instincts of the former leading them to the brighter flowers, which secure, in consequence, more complete fertilisation. Helmholtz sought in the greater brilliancy of the sunlight in such regions the explanation of the phenomenon, and the more highly ozonised state of the atmosphere has also been suggested as an explanation. Referring to the theory that the brightness of colour is the result of competition for insect-visits, Mr. A. W. Bennett remarks[2] that a doubt is raised as to whether this is the true explanation, from the fact that a comparatively small number of alpine plants are dependent on the ripening of the seeds for their propagation. No doubt this is so, but it does not lessen the great importance to the plant of cross-fertilisation and the strengthening of the race by the introduction of new blood. Many lowland plants, which possess creeping rhizomes or stolons by which they would be extensively propagated, even if they never flowered, have, notwithstanding, complete and elaborate arrangements to ensure fertilisation.

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[1] J. Joly, "On the Bright Colours of Alpine Flowers." *Scientific Proceedings of the Royal Dublin Society*, N.S., vol. viii. part 1 (1893).

[2] "The Flora of the Alps," vol. i. Introduction (1896).

This discussion leads us to the larger question of the **colours of flowers**. What influences have determined the particular tints that flowers assume? Why are Buttercups yellow, and Stitchworts white, and Gentians blue, and Willow-herbs rose or pink? There is a reason for all such things, if we can only find it. If we cannot, we must not assume that no reason exists, but say rather that we have not yet discovered it. Mr. Grant Allen has written an essay on this subject,[1] to which we may well turn for information; even if we do not care to adopt the theory which he advances, and if we think that certain modifications in flowers may be open to other interpretations, more satisfactory than those which he puts upon them, nevertheless we shall find in his little book answers to many of the questions that arise in our minds, and suggestions that may aid us in the consideration of others.

Grant Allen's arguments are based very largely on an important postulate—that petals and sepals are modified stamens, not modified foliage-leaves. That stamens and carpels were originally developed from leaves is held to be undeniable; but this tremendously important evolution took place at a period exceedingly remote, the development of petals and sepals being a comparatively recent advance. As evidence in favour of this postulate it may be noted that the most primitive types of flowers now existing, such as the foreign Cycads and our own Fir-trees and Junipers, are devoid of calyx and corolla; and the past history of vegetable life on the globe, as told to us by palæontologists, shows that plants of the great division (Gymnosperms) to which these plants belong, existed long before any races with showy corollas had appeared. The stamen must therefore be the older organ (Mr. Allen argues), the petal and sepal the newer; and that the petal and sepal were evolved from stamens, and not from foliage-leaves, is shown by the interchangeability which still exists between these parts, and proves their affinity. Thus, in a normal white or yellow Water-Lily, the stamens pass by gradual stages into the petals, as we may see for ourselves any summer's day by gathering them; and in double flowers we have innumerable instances of the ready conversion of stamens into petals. Further, the sepals and petals are frequently indistinguishable, as we have noticed in many of the plants examined in our previous rambles. The petals, then, according to this view, are stamens modified and set apart for the purpose of attracting insects to the flower. The still further modified sepals sometimes serve the same object; more frequently their duty is to protect the young flower from cold and damp and animal enemies.

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[1] "The Colours of Flowers as Illustrated in the British Flora" (Nature Series, 1882).

The stamens of the most primitive existing flowers being yellow, Grant Allen concludes that this is the original colour of stamens, and that petals should therefore be of the same hue in petal-bearing flowers of primitive form. The most primitive form is that found in the Buttercups, Potentillas, &c., where a number of separate carpels are surrounded by a number of separate stamens enclosed by a regular corolla, composed of separate petals; and, in point of fact, the petals of these flowers are, as a rule, yellow. In these very simple flowers the honey is accessible to all comers. From this original colour our essayist goes on to show that a regular gradation of colours is found, through white, red, and purple to blue, which is considered the highest and most specialised flower-colour. Blossoms of these different tints are, as a rule, visited and fertilised by different kinds of insects. "Flowers which lay themselves out for fertilisation by miscellaneous small flies are almost always white; those which depend upon the beetles are frequently yellow; while those which specially bid for the favour of bees and butterflies are usually red, purple, lilac, or blue. . . . Blue flowers are, as a rule, specialised for fertilisation by bees, and bees therefore prefer this colour; while conversely the flowers have at the same time become blue, because that was the colour which the bees prefer. As in most other cases, the adaptation must have gone on *pari passu* on both sides. . . . We thus see how the special tastes of insects may have become the selective agency for developing white, pink, red, purple, or blue petals from the original yellow ones." Given only a slight tendency among flowers to vary in colour, insects, by continual selection of the colours which were most attractive to them, are held to have in this way been the agents of the production of the varied hues that we now find in flowers on every hand; just as, by choosing those flowers which, by a slight modification of form, in some way best suited their visitors, insects are held responsible for much of the variety of shape that we find in entomophilous flowers. Alteration of colour and of form have gone on together, and so it is pointed out that while the simplest and most primitive flowers are mostly of the most primitive colour—yellow, the more specialised and complicated a flower becomes, the more does its colour usually vary, changing to white in slightly-altered forms, to shades of red and purple in higher forms, and finally to blue in the most specialised. "And if the more specialised and modified flowers . . . showed a natural tendency to pass from yellow through pink and red to purple and blue, it would follow that the insects which were being evolved side by side with them, and which were aiding at the same time in their evolution, would grow to recognise these developed colours as the visible symbols of those flowers from which they could obtain the largest amount of honey with the least possible trouble. Thus, it would finally result that the ordinary unspecialised flowers, which depended upon small insect riff-raff, would be mostly left yellow or white; those which appealed to rather higher insects would become pink or red; and those which laid themselves out for bees and butterflies, the aristocrats of the arthropodous world, would grow for the most part to be purple or blue."

Instances supporting this assertion will readily occur to the reader. The simple unspecialised flowers of Potentillas and Buttercups, Chickweeds and *Umbelliferæ*, from which any insect can sip honey, are yellow or white. Some of these plants are visited by a surprising number of different kinds of insects. Hermann Müller records 118 species of insects as visiting the umbels of the Cow-Parsnep, *Heracleum*, 104 those of the Bishopweed, *Ægopodium*, 73 those of the Wild Chervil, *Anthriscus sylvestris*. Of these visitors none were butterflies or moths; the percentage of bees in the three cases was only 11, 14.4, and

6.8 respectively; while the remaining 89, 85.6, and 93.2 per cent. was made up of flies, beetles, &c. The most specialised flowers, on the other hand, are those like the Labiates, *Leguminosæ*, *Scrophularineæ*, and Orchids, where the whole shape of the flower is profoundly altered to suit insect visitors of the highest type and to utilise their services; and here purple and blue shades are frequent.

Numerous exceptions, however, remain to be explained. Among certain flowers of primitive form the colours which accompany high specialisation are found: note the scarlet, purple, and blue Anemones, and the red Potentillas. Conversely, among the most highly specialised plants, some species have yellow flowers, the most primitive colour of all—the Gorse and the Broom, *Lamium Galeobdolon*, *Verbascum Thapsus*, to quote familiar instances. Others are white, such as *Trifolium repens*, *Habenaria bifolia*, and British species of *Spiranthes* and *Cephalanthera*. Yet these are visited and fertilised by bees and other highly-specialised insects. Grant Allen sets down exceptions of the latter series to "retrogression." "Flowers which have reached a given stage in the progressive scale of coloration," he says, "often show a tendency to fall back to a lower stage." He points out that primary yellow flowers show little tendency to vary in colour in a state of nature. Some white flowers, on the other hand, occasionally revert to yellow. Pink and red flowers almost invariably revert in many individuals to white, and blue flowers in nearly every case produce abundant red, pink, and white varieties under natural conditions, though relapses to the primitive yellow are very rare. Permanent reversions are explained as due to special circumstances having rendered a change to a colour lower in the progressive scale advantageous. As illustrations, the yellow Evening Primrose and the white Evening Campion, both of which come of red-flowered races, are quoted. These plants having taken to nocturnal habits, their flowers, if they were red, would not be seen, and the flowers have therefore reverted to the more conspicuous shades of yellow and white. The explanation of many other cases, as the author confesses, is not so apparent. All green flowers, such as those of Lady's-mantle, Docks, and Goose-foots, are likewise held to be degraded types. Under the title of "variegation," the phenomena of lines, stripes, or spots of a second colour on the petals of flowers are discussed. Many of these, as Sprengel pointed out more than a hundred years ago, no doubt act as honey-guides, directing the insect visitor to where it will find the nectar and at the same time fertilise the flower. Such stripes and spots are most frequent on highly-specialised flowers, such as Labiates, Orchids, and *Scrophularineæ.* On regular flowers they frequently take the form of darker pigment along the veins of the petals, but in the more complicated irregular blossoms they often exhibit an intricacy and variety of tint that is astonishing, and which, at present, we are not able to interpret.

Space does not permit of reference to other views relative to the origin and significance of flower-colours. With Grant Allen's little book as a text, the question has already been discussed at a length greater than that which has been allowed to some other subjects of equal importance. The colours of flowers are so constant a source of pleasure to ourselves that the question of their origin especially arouses our interest, and the subject is one which invites further observation and experiment. If the student will read Lubbock's "British Wild-Flowers considered in Relation to Insects" as a simple introduction to the general question, and Grant Allen's essay on this special subject, and finally turn to Hermann Müller's great work, "The Fertilisation of Flowers,"[1] he will be equally impressed with the intense interest of what we know of these matters, and with the width and variety of the field that still lies before us for investigation.

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[1] Translated and edited by D'Arcy W. Thompson (1883).

SCENE XI

A CITY RUBBISH-HEAP

(DUBLIN, *September* 1896.)

A STRANGE place to choose for a study in wild-flowers! A square plot, perhaps half an acre in extent, shut in on every side by grimy buildings and high walls, and overhung by the yellow, foggy, city sky. At one side rises the gaunt soot-stained wall of a mill; elsewhere are dirty brick gable-ends, and crazy sheds with windows of dull lustreless glass. In one spot a stone wall bulges forward; at another great beams of wood, green and slimy, are propped against the end of a poor tenement-house, and alone restrain it from collapsing bodily into the vacant plot. The ground here is covered with heaps of bricks and rubbish, piles of cinders, of chaff, of sawdust, and mouldering walls, the remains of bygone buildings. One would think that the sun never shone here; everything is dark, grimy, saturated with smoke and fog and evil smells. Above the dull humming of the machinery in the adjoining mill comes the roar of the city outside, the clatter of horses' hoofs, the rattle of cabs, the rumble of heavy-laden drays.

Yet even here the wild-flowers have found their way:—

> " With such a lib'ral hand has Nature flung
> Their seeds abroad, blown them about in winds,
> Innumerous mix'd them with the nursing mould,
> The moistening current, and prolific rain."
> —THOMSON, " *The Seasons.*"

An irregular mound over at one side of this waste appears to be the focus of the flora. It is composed of all the flotsam and jetsam of the city—broken bricks and mortar, mud, black piles of soot, straw and shavings, old slates and laths. A cart-track leads to it from the battered gateway by which we entered, showing that most of the rubbish has been carried hither. The track wanders through mounds covered with rank grass, and groves of tall Docks and yellow Ragwort, and tangles of Orache and Knot-grass. On the large rubbish-heap which has attracted our attention the vegetation is more varied. A tall Teasel rises full five feet, with spiny stems and purple bristly flower-heads, and leaf-bowls all filled with rain. It is rivalled in conspicuousness by a huge Henbane, with long arching branches clothed with clammy poisonous leaves, and tipped with weird lurid blossoms. Around its base the Annual Mercury forms a dark-green shining forest in miniature. Here and there long-podded yellow-flowered Crucifers of several species flourish; and in one corner are huddled together half-a-dozen unfamiliar plants that we cannot recollect having met with before. Even the crumbling wall-tops have their decoration of greenery; the Dyer's Rocket rises erect and unbranched, and Chickweed straggles among the loosened bricks. The very eaves-gutter high above is tenanted with clumps of verdant grass, and from this point of vantage the Groundsel launches its floating fruits.

When we think how in the bright daylight of the open country plants strive for light, elbowing and pushing each other, climbing on each other's shoulders, we wonder that in this foul smoky atmosphere, in this high-walled dungeon where sunlight scarcely penetrates, wild-flowers can live at all. And in truth many of them came hither unwillingly, brought from brighter places in the course of man's operations. The Teasel, for instance, is not at home here. Could it tell a tale, it would speak of some dry tangled sunny bank where its ancestors lived and died generation after generation. But others appear to actually court the neighbourhood of towns, and are seldom found elsewhere. Two notable examples of such plants are here—the Annual Mercury, *Mercurialis annua*, and the London Rocket, *Sisymbrium Irio.* Others, as we shall see later, are strangers in a strange land, which human trade and intercourse have brought from far-distant climes.

Let us begin by examining the tall **Teasel**, which dominates all the other vegetation of the rubbish-heap. This is a biennial plant. In one year it germinates and produces a rosette of large lanceolate leaves, with scattered prickles on their surface; the following season it sends up a tall stem with axillary branches which bear flower and fruit, and the plant then dies. The stem is tough and prickly, with long internodes. At each internode is produced a pair of large sessile leaves, the bases of which join at each side of the stem to form a bowl, which even in dry weather is always filled with water; and out of the centre of the bowl rises the next internode. The use of these bowls in the economy of the plant has been suggested in a previous chapter (p. 190). Towards the summit of the stem the armature of spines becomes more formidable, and each branch ends in a large egg-shaped head of lilac flowers. They are amply protected from the assaults of grazing animals by the long quill-like bract which projects from below every blossom, and by a general involucre of very long herbaceous bracts, well armed with spines, which stand up all round the head. The head bursts into flower not irregularly, but in horizontal rings; each flower has a long tubular corolla split at the ends into five irregular segments. The curious "outer calyx" which envelops the ovary recalls that which we found in the Field Scabious (p. 185). The Teasel belongs to the same Order, which, indeed, takes its name, *Dipsaceæ,* from it, the generic title of the Teasel being **Dipsacus**, and this species **D. sylvestris.** The Teasel's natural home is on rough dry banks, among Brambles and tall grass; and how this plant came to eke out its existence in the centre of the city is a matter of conjecture. The fruit is not winged or feathery. Perhaps a Teasel-head was brought

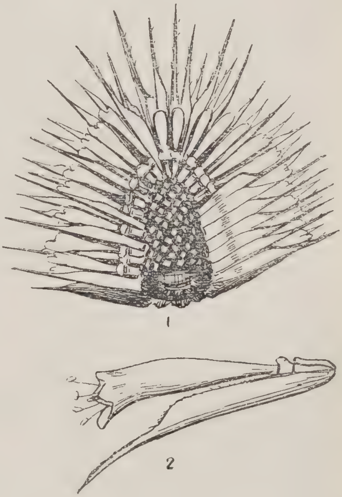

Fig. 65.—Inflorescence of the Teasel, *Dipsacus sylvestris.*

1, Section of the head (two-thirds natural size); 2, a flower and bract (enlarged).

home by some of the poor dwellers hard by as a souvenir of some happy day in the country; perhaps—but why indulge in speculation? More curious questions of the same kind we shall meet with soon. The Clothiers' Teasel is **D. Fullonum**, a plant of uncertain origin, sometimes found in the west of England, where it has escaped from cultivation. It is very like *D. sylvestris*, but the bracts are only as long as the flowers, and are hooked at the tip, and the bracts of the involucre are spreading. This plant has been used ever since the reign of Richard I. in the manufacture of cloth, the tough elastic bracts being serviceable in the dressing of woollen fabrics, the nap of which is raised by Teasel-heads set in a rotating cylinder. It is a curious fact that, despite all the ingenuity of inventors, the heads of the Teasel still hold the field over any artificial contrivances that have been tried.

One other species of *Dipsacus* is found in the British Isles. This is **D. pilosus**, the **Small Teasel** or Shepherd's Rod, not uncommon in England, but absent from Scotland and Ireland. It has large, ovate, serrate root-leaves, and a slender, slightly-spiny stem several feet high, bearing smaller leaves, usually with a pair of leaflets at the base, and globular heads, about one inch across, of white flowers.

We turn to the **Henbane, Hyoscyamus niger**, which, next to the Teasel, is the tallest and most conspicuous denizen of our rubbish-heap. A strange and forbidding plant this. The soft lobed leaves, which spread out in two overlapping rows on each branch, are clammy and sticky, with a strong unpleasant smell. The flowers are borne in a long raceme-like cyme, which is rolled downwards at the tip, so that a few expanded flowers always appear to terminate the shoot. As the flowers fade the stem lengthens and stiffens, and the fruit-capsules form a double row along the stem, each in the axil of a leaf. The flowers are strange and lurid, pale yellow with purple veins. The hairy calyx encloses the large two-celled ovary, and swells as it swells; the fruiting stems form a striking object, as shown by the scrap in the illustration. Each capsule is provided with a beautifully-fitting lid, which, when the numerous seeds are quite ripe, drops off, allowing the seeds to get scattered. The capsules and calyx become woody, and persist after the leaves have all passed away; and in spring one may find the gaunt skeletons of the previous year, white branching stems bearing a double row of bleached calyx-crowned capsules, still standing among the succulent foliage of their offspring. The Henbane is often as strange in its habitats as it is in its appearance. It haunts old graveyards and ruins, and the neighbourhood of houses. It is very uncertain in appearance, growing abundantly for a while and then vanishing suddenly, and often appearing unexpectedly where it was never seen before; hence somehow we are not surprised to meet with it in this deserted and melancholy spot. It is a highly-poisonous herb, and

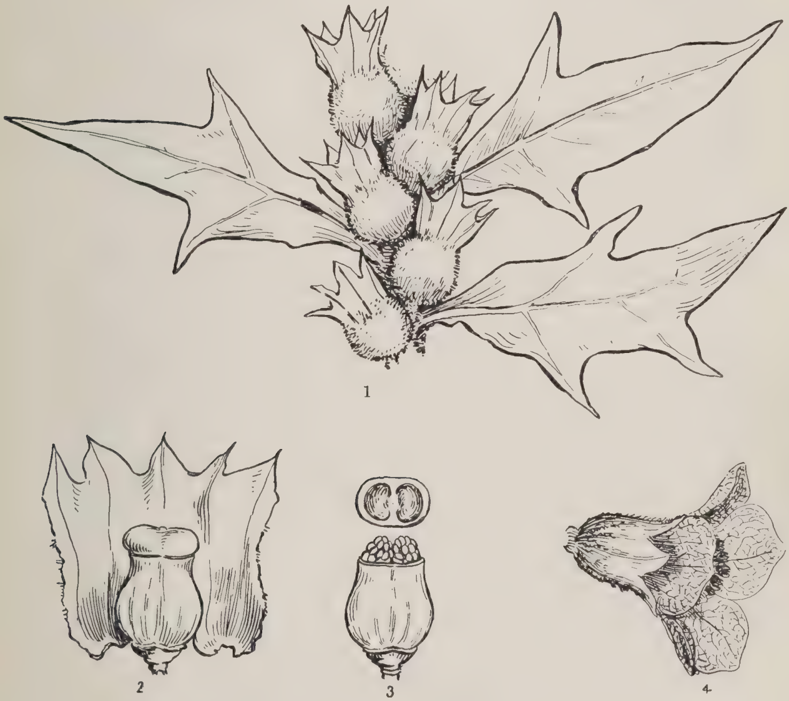

FIG. 66.—HENBANE, *Hyoscyamus niger*.

1, Portion of a fruiting branch (half natural size); 2, fruit capsule, the calyx cut open; 3, fruit with lid raised; 4, flower. (2, 3, 4, natural size.)

comes of an Order containing several poisonous plants, the **Solanaceæ.** The genus from which the Order is named, **Solanum**, is represented in Britain by two species, **S. Dulcamara**, the **Bittersweet** or Woody Nightshade, and **S. nigrum**, the **Black Nightshade**. The Bittersweet is a graceful climbing plant with slender flexuous stems, ovate leaves, often with a pair of pinnæ at the base, and spreading clusters of pretty little purple flowers. The corolla is five-lobed, reflexed. The five stamens are fused together, and project as a yellow column. The fruit is a bright scarlet berry, attractive and ornamental. The **Black Nightshade**, **S. nigra**, is a herbaceous annual, usually found on cultivated or waste ground. It is smaller than the last, the leaves never pinnate, the flowers small and white, and borne in umbels. It is not uncommon in England, but in Scotland and Ireland can be considered only a casual. To the genus *Solanum* belongs the Potato, the tubers of which are so important an article of diet. The flowers and fruits of this plant will be found to exhibit very satisfactorily the characteristic points of the genus. The only other British member of the Order is the famous **Deadly Nightshade, Atropa Belladonna.** It is easily known by its creeping root-stock, broad, ovate, entire leaves, and solitary bell-shaped, lurid, purple flowers. The fruit is a purple-black berry, and is exceedingly poisonous. The Deadly Nightshade grows about ruins and in chalky places. Like the Black Nightshade, it appears to be truly native in some of its English stations alone, but is found in more or less suspicious localities in most parts of our Islands.

Two branched herbaceous plants hard by the Henbane we recognise, from the shape of their small yellow flowers and their long seed-pods, as belonging to the **Cruciferæ.** They have the four sepals, cruciform corolla of four petals, six stamens, four long and two short, and two-celled pod that characterise the Order. The one is the London Rocket, *Sisymbrium Irio*, the other the Flixweed, *S. Sophia*. The London Rocket is very rare, with a curious predilection for the town. Here around Dublin it is a common plant in waste ground and on roadsides, but once we pass the outskirts of the city we seek it in vain. Berwick appears to be the only other station in the British

Isles where it is permanently established; elsewhere it is found only as a waif, and does not remain. Its English name perpetuates the fact that after the Great Fire of London, in 1666, it sprang up in quantity on the burned ground.

Sisymbrium is a genus of annual or biennial herbs, with racemes of small yellow or white flowers and long straight seed-pods. The five British species are not hard to discriminate. The rare **S. Irio** has glabrous leaves, the lower ones pinnatifid or deeply lobed, the upper narrowly lanceolate, often with a pair of small leaflets at the base. The flowers are pale yellow, the pods narrow, two to three inches long. **S. Sophia**, which grows with it on our rubbish-heap, may be known from any other pod-bearing British Crucifer by its pretty finely-divided leaves, cut in a tripinnate manner into linear segments. The flowers are very small and bright yellow; the pods an inch long, beaded, and erect. It is not uncommon on waste land and sandy soil in most parts of the British Isles. **S. officinale**, the **Hedge-Mustard**, is a common weed everywhere. The lower leaves are pinnatifid with a large terminal lobe, the upper ones narrow with one or two pairs of narrow lobes. The flowers are small and yellow, pods almost sessile, only half-an-inch long, and closely adpressed to the stem. **S. Alliaria**, the **Garlic-Mustard**, or Jack-by-the-Hedge, is a plant of different appearance. The leaves are thin, broad, and undivided, the root-leaves somewhat kidney-shaped, the upper cordate, all with a coarsely-toothed margin. The flowers are white and rather conspicuous, and a colony of the plant in full flower in some shady hedgebank in May is an attractive sight. The last species, **S. Thalianum**, the **Thale-cress**, is a little wiry annual, haunting walls and rocks. It might be passed over at first glance as *Cardamine hirsuta*, but its leaves are simple, hairy, and toothed, not pinnate, and the slender pods are usually widely spreading.

The **Annual Mercury, Mercurialis annua**, by its abundance, and its profusion of dark-green foliage, does its best to hide from view the unsightly bricks and old tins and other rubbish. Even more than the London Rocket this is a plant of the city. Here in Dublin it fills every back-garden, covers every heap of rubbish, flourishes even in stone-floored yards and areas, rooted firmly in the chinks between the flags; and elsewhere it is generally found about towns and villages.

This is a herbaceous annual, with many pairs of opposite branches and ovate acute serrate leaves. It is diœcious. Some plants produce slender, upright, axillary flower-stems, bearing a number of tiny blossoms, which consist of a green three-parted perianth and a cluster of yellow stamens. Other plants produce short axillary clusters of female flowers, which have a similar perianth surrounding a rough two-celled ovary surmounted by two styles. A portion of the male and female plants is shown in the drawing. One other species of Mercury is found in Britain. This is the

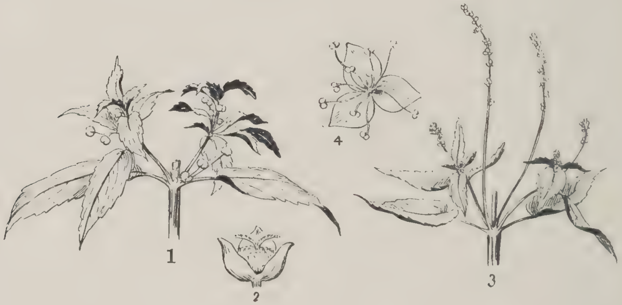

FIG. 67.—ANNUAL MERCURY, *Mercurialis annua.*

1, Portion of female plant (one-third natural size); 2, female flower (enlarged); 3, portion of male plant (one-third natural size); 4, male flower (enlarged).

Dog's Mercury, M. perennis, a plant of shady woods and hedgebanks. It has a perennial, white, creeping rhizome, from which spring unbranched leafy stems a couple of feet high, with leaves and flowers much like the last, but the leaves are broader and hairy. The Mercuries belong to the Order *Euphorbiaceæ*, of which in a previous chapter (p. 72) we examined certain species of the typical genus *Euphorbia* or Spurge.

The rank Nettles which occupy one deserted corner are worth examining also. The two species which are native in Britain are well known to every country child. The **Common Nettle, Urtica dioica**, which grows here six feet high, has a perennial creeping root-stock, which sends up tall annual stems with heart-shaped, downy, dark-green leaves and long flower-panicles. The **Small Nettle, U. urens**, is also here, growing on dry rubbish. It is an annual, generally not more than a foot high, with shining, coarsely-toothed, elliptical leaves and short flower-clusters. The **Roman Nettle, U. pilulifera**, found in the east of England, is an alien plant, distinguished by the female flowers being grouped in globose clusters.

The **stinging hairs** of nettles, which we all know so well, are of great interest, as being the only structures of the kind met with in our native flora. Each hair consists of a single elongated cell, springing from a little cushion of cells belonging to the epidermis or outer coating of the leaf. The hair is tapering, and terminates in a little knob, which is bent to one side. The wall of the cell just below this knob is extremely thin. If the tip of a hair be touched, even very lightly, the knob breaks off, and the oblique point thus left readily penetrates the opposing body, and the contents of the hair are ejected through the minute opening made by the fracture at its apex. These contents consist of formic acid and another highly-poisonous substance, and it is the ejection of these poisons into the flesh that produces the well-known pain of Nettle-stings. It is easily seen what an admirable protection against the attacks of grazing animals these tiny poison-hairs are, and we cannot fail to be struck with the simplicity and efficiency of the mechanism by which the result is brought about. The poisonous qualities in the hairs are dissipated by heat, and the young shoots of the Common Nettle, if boiled, form an agreeable vegetable. Certain foreign Nettles are far more formidable than our native species. An Australian species forms trees with trunks twenty feet in circumference; and others found in India and Java produce serious illness, the symptoms resembling those of snake-bites.

The Order to which the Nettles belong, **Urticaceæ**, includes plants of various habit—the **Wall-Pellitory, Parietaria diffusa**, a hairy herb with light-green ovate leaves and abundant axillary clusters of minute red flowers; the **Hop**, with tall twining stems, vine-like leaves, and green spreading panicles of blossom; and the stately

Elm, one of the largest and handsomest of our forest trees.

On a little bare mound, otherwise almost untenanted, grow several strange plants that strike us as quite unfamiliar. They are all annuals, as we judge by their short roots and absence of root-stock or of radical buds. They appear to be at home here, yet, should we revisit the spot next year, we shall probably find not a trace of any of them. They are foreigners, brought to this uncongenial spot by the vicissitudes of fortune. For one generation they may flourish and brighten the dull scene, but they will fail to ripen their seed, owing to the want of the warm sunlight to which they are accustomed, or their seeds may not survive our long damp winter; for one reason or another our climate does not suit them, and they will soon die out. In the long course of time they have adapted themselves more and more to their usual conditions of life, and a certain amount of sunlight, of rain, a particular climate, in fact, have become necessary to them. Though they might by degrees become reconciled to considerable changes—and in this character plants vary a great deal—a sudden change is not provided for in their economy, and under conditions too much altered their vital arrangements break down. Other plants appear to possess a much greater adaptability, and settle down quietly as colonists in a new land; while some not only hold their own, but spread rapidly and overrun large areas. A notorious example of the latter kind we have already seen in the Canadian Weed, *Elodea canadensis* (p. 62). One of the strangers of our rubbish-heap is a plant of similar tendencies—the **Yellow Monkey-flower, Mimulus luteus.** Its home is in America, along the Pacific slope. Thence it came to Britain, introduced perhaps deliberately, for it is a handsome plant, perhaps accidentally with other roots, or seed of some kind. Now it has run altogether wild, and appears to delight especially in the gravelly banks and beds of streams in hilly districts. How it came to grow here in the city is not clear. Perhaps it exists in some window-garden not far away; but that some other agency is at work which brings here Western American plants is shown by its neighbour, a little bristly Bugloss-like plant with small yellow flowers. This is **Amsinckia**

lycopsoides, a native of California. How did it get here? It is not a plant that would be cultivated for its beauty, nor is it useful to man. Its introduction was no doubt accidental, and probably the American wheat-ships brought it across the water. With these plants of the Far West grow one or two which have come hither from the East. This little erect plant with leafy stems, small white flowers, and flattened seed-pouches is **Lepidium Draba**, which is found all over Central and Southern Europe. That graceful herb, which we recognise as one of the **Melilots**, is **Melilotus parviflora**, easily known from other species occurring in Britain by its very small yellow blossoms; it is found all over Southern Europe, but in Britain only as an occasional casual. Another *Lepidium* is here, a remarkable little plant. The stems rise erect, branched only at the top. The lower leaves are cut into numerous hair-like segments; the upper are so different that we might well believe they belonged to a different species. They are very broad and quite undivided, pointed at the apex, perfoliate at the base; that is, the leafy membrane entirely surrounds the stem. This is **Lepidium perfoliatum**, whose home is in the East; in Bohemia, and Dalmatia, and Thrace. Nowadays, what with the large imports of foreign wheat and other seeds, these Continental plants are constantly showered down on our Islands. Most of them survive but a single season, but no doubt some of them will in time become acclimatised. For an instructive history of the fortunes of many such waifs, and native plants as well, during several seasons, the reader may turn to Professor Traill's "Florula of a Piece of Waste Ground at Aberdeen," which was referred to on a previous page (p. 208). The scene of this study in **casuals** is a piece of ground seven or eight acres in extent, raised by continued deposition of carted rubbish from the foreshore of the river Dee, and then enclosed with a high paling, by which further change was prevented, and the plants which came there were left undisturbed. Along the north side ran railway sidings, where the soot from the noisy engines blackened the vegetation. At the south end were flour-mills, which covered the plants with a white coat of dust. Railways are a fertile source of strange plants; sidings, where goods from distant places are handled, particularly so. Flour-mills are still more a centre of dispersal of foreign weeds, on account of the grain from distant countries which is constantly passing into them. When in addition it is remembered that the ground itself was made of rubbish from all sorts of places, it will be seen that here was a spot where a mixed crowd of plants, of all ranks and of all countries, might be expected; and Professor Traill has carefully noted their coming and going for four years, and watched the struggle for mastery which was ever going on. The results are given in a table, showing the occurrence and frequency of each plant during the last four seasons; British plants which owed their introduction to artificial causes being distinguished by an asterisk, and foreign species by italic lettering. A summary of this tabular view is instructive:—

	1893.	1894.	1895.	1896.
Native species	97	74	78	96
British casuals	37	20	18	14
Foreign casuals	58	27	23	24
Totals	192	121	119	134

It is to be remarked that the summer of 1893 was unusually dry and warm, and this no doubt aided the growth of many of the introduced plants, which numbered in this season no fewer than ninety-five species. It will be seen that a large diminution in all three divisions of the flora occurred in the second year. This is no doubt due to the crowding out of many annual plants by the more aggressive perennials; the British plants missing in the second year are chiefly annuals; the bulk of the casual species throughout the period of observation were annuals also, and both the British and foreign casuals largely disappear in the second year. The winter of 1894–95 was exceptionally severe; but this does not appear to have affected the flora so far as numbers are concerned, and the totals for 1895 are almost identical with those of the previous year. 1896 is chiefly remarkable for an increase in the indigenous flora, and an examination of Prof. Traill's table shows that the new plants are chiefly perennials, which apparently were able to elbow their way into the crowd, no doubt assisted by their adaptation to the soil and climate, and their power of maintaining their ground during the winter months. There can be no doubt that only the constant introduction of fresh seed from the flour-mills kept up the stock of foreign plants; and in a few years more these, and eventually almost all the annual plants, will disappear, if the place is left undisturbed, as the perennials spread and steadily usurp more and more of the ground.

These fleeting waifs from foreign lands have an interest of their own; a glamour of romance hangs around their unfamiliar leaves and blossoms; and even amid the unromantic surroundings of our rubbish-heap, in grime and smoke, with sooty walls and unsightly squalor before our eyes, and the harsh noises of the busy streets in our ears, our minds may wander away across the seas to the distant homes of these poor strangers—to the vineyards of France, the wheat-lands of the Baltic and the Black Sea, or to where, beneath Californian skies, the broad Pacific leans against the edge of the New World.

And now, having rambled thus far through sweet meadows and over brown bogs, along pebbly beaches and among mountain crags, studying the wild-flowers in their homes, and endeavouring to learn something of their life, it may be well, before concluding, to give the beginner a few hints as to the preservation of those specimens which he wishes to keep for reference, and also as to the books to which he may refer for information regarding British wild-flowers. As to books describing our native flora, Johns's "Flowers of the Field"[1] has never been surpassed as a beginner's guide to field-botany. The language is simple, the descriptions terse, and the numerous woodcuts excellent. More advanced students will require the standard manuals of Babington,[1] Hooker,[2] or Bentham.[3] The last-named is illustrated with a small woodcut of every plant. Fitch and Smith's "Illustrations of the British Flora"[4] consists of the last-mentioned illustrations, reprinted without letterpress, and will be found a useful companion to unillustrated works. To these must be added some work on local geographical botany, by which the student may ascertain the distribution of plants in his district—a county flora, if one has been published, or Watson's "Cybele Britannica,"[5] "Compendium of Cybele Britannica,"[6] or "Topographical Botany,"[7] which show plant-distribution throughout Great Britain; or Moore and More's "Cybele Hibernica,"[8] which does the same for Ireland. As regards other branches of botany, reference has been made to accessible books on various subjects when these subjects were discussed in the preceding pages. Those who wish to possess a general work in which the field-botanist will find information on almost every question, will do well to invest in Kerner's "Natural History of Plants,"[9] recently translated under the editorship of Professor Oliver; it will prove a veritable encyclopædia of fascinating interest.

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[1] S. P. C. K. (28th edition, 1894).

To the value of a collection of dried plants some reference has already been made. A well-dried specimen will convey a better idea of the actual appearance of a plant when alive than can be furnished by a whole page of scientific description, or even by a good drawing, and a carefully-prepared series of dried plants affords opportunities for the comparison of different forms of the same species, or of closely-allied forms, such as one cannot hope to obtain in the field. But our dried specimens must never *replace* the living plants for purposes of study. They are at best but the poor embalmed mummies of the living, moving, breathing plants. To be true botanists, we must make the woods and fields our laboratory and herbarium. There alone we may hope to obtain a glimpse of the life of plants, with its struggles and trials, successes and failures, for, indeed, their "pains are scarcely less than ours." Watch how the plants are fertilised and how their seeds are dispersed, and you will probably have the key to the size, shape, and colour of their flowers on the one hand, and to their distribution in the neighbourhood on the other; the nature of their food-supply and of their rootstocks, whether upright or creeping, annual or perennial, will also have much to say to the latter question, as will likewise the abundance or scarcity of beneficent or injurious animals, from the tiniest ant to the great bulky cattle.

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[1] Babington, "Manual of British Botany" (8th edition, 1881).

[2] Hooker, "Student's Flora of the British Islands" (3rd edition, 1884).

[3] Bentham, "Handbook to the British Flora," vols. i.–ii. (1865).

[4] 1880.

[5] Vols. i.–iv. (1847–59).

[6] 1870.

[7] 2nd edition, 1883.

[8] 1866. (New edition in preparation.)

[9] Vols. i.–ii. (1894–95).

But it is necessary that we should be able to recognise and name our plants, and here the herbarium will prove of much service. First, then, as to the **collecting** of our specimens. A specimen should, where possible, show every portion of the plant—root, stem, leaves, flower, fruit; but care must be taken that our desire for perfect specimens does not endanger the plant's existence. The ignorance or greed of collectors is directly responsible for the extermination of many a wild-flower in one or other of its haunts—to their shame be it spoken. We must never forget that we are the custodians for the time being of our native flora, and we should endeavour to fulfil the trust so that it will be none the worse for our guardianship. What with the growth of our cities, the spread of agriculture, the draining of marshes, and other operations that are ever going on, our wild-flowers have sufficient dangers to contend with. Let it not be said that we who call ourselves botanists have joined hands with the enemy. Be careful, therefore, in selecting your specimens, to be modest in your demands; gather them with a due regard to the continued life of the plant. An annual that is dependent on the ripening of its seeds year by year for its very existence cannot endure the collector's visits as can a perennial with a creeping rhizome far down in the ground out of harm's way.

Specimens intended for preservation should be gathered, when possible, on a dry day. As to how the plants should be carried home, tastes differ. Some use a portfolio in which sheets of absorbent paper are pressed between two latticed covers by leather straps; others prefer the vasculum or tin case, in which most flowers will remain fresh for some hours, especially if the air be kept moist with a small sponge, or pad of damp cotton-wool. In either case, the plants should be transferred, on arrival home, to the **drying-press.** This consists of sheets of absorbent paper placed between boards and compressed by means of either weights or strong straps. As regards the paper used, special paper for drying botanical specimens, resembling thick soft blotting-paper, is manufactured and sold by several firms. Good paper may be obtained from Messrs. West, Newman & Co., 54 Hatton Garden, E.C., at from 1s. 1d. to 2s. 2d. per quire, according to the size of the sheet, which ranges from 16 × 10 inches to 20 × 16 inches. Those who are economically disposed can, with proper care, obtain excellent results from thick, unsized brown paper or from newspaper. I have dried Hawkweeds in old newspapers with results so satisfactory as to elicit favourable comments from a well-known authority on that difficult genus. In drying plants, the elements of success depend largely upon using plenty of paper, plenty of pressure, and changing the paper frequently. The time which a plant takes to dry varies according to its nature. A Grass, once placed in drying paper, often does not suffer if the paper is never changed, and is dry in a few days; some of the Stonecrops are so tenacious of life that at the end of six weeks' continual squeezing and changing of paper, they are still complacently growing. The succulence of the plant must be the guide in all cases; with the majority of plants it is well to put them into dry paper every day for several days, every second day for another week, and every third or fourth day after that till they are quite dry, which can be best tested by laying them against one's cheek, when, if any moisture remain in them, the coldness of the touch will be apparent. In first putting the plants into paper, care should be taken to spread them out; but this can be better done on the succeeding day, when the specimens will have become limp. The leaves and flowers should then be arranged so as to display to the greatest advantage the characteristics of the plant. It will be found that a little pad of cotton-wool laid above and below each blossom of a specimen will assist materially in preserving both its colour and appearance. The cotton-wool pad should not in these cases be opened or removed till the process of drying is completed. No specimen should be put into the drying-press without a slip on which are recorded the date and locality, and the finder's name, if necessary; these particulars are required for the herbarium, and, if left to memory, serious errors are sure to occur.

When the plants are thoroughly dry, most collectors take the precaution of poisoning them, as a preventive against the attacks of moths, beetles, and mites. An effective **poisoning solution** is obtained by dissolving $\frac{1}{4}$ lb. corrosive sublimate and $\frac{1}{4}$ lb. carbolic acid in a gallon of methylated spirit. This solution should be painted over each side of the specimens before they are mounted, with a soft brush. In some large herbaria, however, poisoning of the plants is not resorted to, and reliance is placed on naphthaline or albo-carbon, of which a constant supply of small blocks is kept in the cabinets in which the plants are stored.

Finally, the plants should be **mounted,** by means of thin gummed strips of paper, on sheets of a good stiff white paper. A stout printing-paper at about eight shillings per ream will be found satisfactory and economical, but a thicker paper is preferable for permanent mounting. The name of the plant, the place where it was collected, the date of collection, and the collector's name, should then be written on the sheet, and the specimen should be transferred to the cabinet, where the plants are classified according to the Natural System, the Natural Orders, genera, or species being arranged in covers, according to the size of the collection.

But let it be remembered that the amassing of a collection of dried plants is not botany. By studying them we undoubtedly learn much; by growing them in our gardens unspeakably more; but the full light of knowledge can be obtained only by observing them in the homes which they themselves have selected, and where they take their natural places in the plant-community. If we wish to *know* our plants, we must begin, as Professor

Geddes says, "neither with conning an inventory of plant-mummies, nor with the tissue-unwrapping of samples of these; but with childlike watching, scene after scene, of the actual drama of Nature, in which life interacts with life, and fate with all."

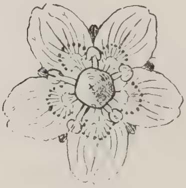

FIG. 68.—FLOWER OF GRASS OF PARNASSUS, *Parnassia palustris.*

> "Parnassian grass, with chaliced bloom
> And globes nectareous, like the earl's
> Rich coronet, beset with pearls."
>
> —BISHOP MANT.

GLOSSARY

Achene—a dry one-seeded indehiscent fruit.
Acute—pointed ; forming an acute angle at the tip.
Adhering—the uniting of different parts of a flower.
Adpressed—pressed close.
Albumen—nutriment stored up in a seed, apart from the embyro.
Alternate—placed successively on the different sides of a stem.
Anemophilous—fertilised by wind-borne pollen.
Annual—living but one year.
Anther—that part of a stamen which contains the pollen.
Apiculate—ending in a small hard point.
Ascending—curving upwards.
Assimilation—the process by which leaves decompose carbonic acid water, &c., and form therefrom food-materials.
Awn—an elongated bristle, formed by the prolongation of a midrib.
Axil—the upper angle formed where a leaf joins a stem.
Axillary—springing from an axil.
Axis—a central line ; a central stem.

Barren—producing no fertile seed.
Beak—a pointed prolongation.
Beard—a tuft of soft hairs.
Berry—a pulpy fruit containing several seeds.
Biennial—living for two years.
Bifid—split half-way down into two.
Bipinnate—twice pinnate ; pinnate with pinnate divisions.
Blade—the flattened portion of a leaf.
Bract—a small leaf placed close below a flower.
Bulb—a flattened root-stock clothed with fleshy scale-leaves.
Bulbiferous—bearing bulbils.
Bulbil—a bud which becomes detached and grows into a separate plant.

Calyx—the outermost floral whorl, consisting of sepals.
Calyx-tube—a tube formed by the cohesion of sepals.
Capillary—hair-like.
Capitate—gathered into a head or close tuft.
Capsule—a dry dehiscent seed-vessel.
Carpel—that portion of a flower which contains an ovary ; one female floral leaf.
Catkin—a deciduous unisexual flower-spike.
Chlorophyll—the green colouring matter of plants, which is capable of decomposing carbonic acid.
Ciliate—fringed with a row of hairs.

Claw—the lower narrow portion of a petal.
Cleistogamous flowers fertilise themselves without opening.
Cohering—the uniting of similar parts of a flower.
Column—the prolongation upwards of the ovary in the flower of Orchids.
Conduplicate—folded upon itself longitudinally.
Connate—joined together by the edges.
Cordate—heart-shaped, with rounded lobes at the base.
Corm—a bulb-like fleshy root-stock without scale-leaves.
Corolla—the inner whorl of the perianth, composed of petals.
Corymb—a flat-topped inflorescence formed by the lower branches of a raceme being longer than the upper.
Cotyledon—the first leaf of a plant, developed inside the seed.
Creeping—procumbent and rooting.
Crenate—having rounded marginal teeth.
Cyme—"inflorescence formed of a terminal flower, beneath which are lateral branches, each having a terminal flower, and lateral branches again similarly dividing."

Deciduous—soon falling off.
Decumbent—lying on the ground, but rising at the end.
Deflexed—curved downwards.
Dehiscent—opening by valves, pores, &c.
Dense—having the parts placed close together.
Dicotyledonous—having an opposite pair of cotyledons or seed-leaves.
Dimorphous—having the same organ of two lengths or shapes in different flowers of the same species.
Diœcious—having the male and female flowers on different plants.
Disk—the central portion of the flower-heads of radiate *Compositæ*.
Drupe—a pulpy fruit containing a single seed enclosed in a stony envelope, as a plum.

Elliptic—oval, but pointed at each end.
Embryo—the young plant when in the seed.
Embryo-sac—the cell which contains the embryo.
Entire—not notched, toothed, or divided.
Entomophilous—fertilised by insect-borne pollen.
Epicalyx—a calyx-like group of bracts outside the true calyx.
Epidermis—the skin or outer layer of cells.
Epigynous—seated upon the ovary.
Epipetalous—seated upon the petals.
Epiphyte—a plant which grows upon another, but is not parasitic upon it.

Female—bearing pistils.
Fertile—producing mature seed.
Fertilisation—impregnation; "the process by which the pollen reaches and acts upon the ovules, and results in the production of fruit."
Filament—the stalk-like portion of the stamen.
Filiform—thread-like.
Floret—one of the flowers of a head in *Compositæ*.
Flower—the portion of a plant which is devoted to the production of seed.
Fringed—having a frilled margin.
Fruit—the seed-vessel with its contents and appendages.

Glaucous—with a greyish-green or bluish-green colour.
Globose—globular, spherical.
Glume—the chaffy outer scales of the flowers of Grasses and Sedges.
Granular—roughened with small points.

Head—a compact terminal cluster of flowers.
Herb—a plant which does not produce perennial woody tissue.
Herbaceous—not woody; green and leaf-like.
Hispid—bearing stiff hairs.
Hoary—covered with grey or white down.
Host—the plant upon which a parasite lives.
Hybrid—a plant produced by the crossing of two species.
Hydrophyte—a plant that lives under water.

Imbricated—crowded and overlapping.
Imperfect—of a flower, not containing both stamens and pistils.
Indehiscent—not opening or emitting contents.
Inferior—placed below anything; an *inferior calyx* or *corolla* is below and free from the ovary; an *inferior ovary* bears the calyx, corolla, &c., on its upper end.
Inflorescence—the arrangement of the flowers on the stem; the flowers and their supporting stems.
Internode—the space between two nodes on a stem.
Involucre—a ring of bracts surrounding a flower-head; a *general involucre* surrounds the base of a compound umbel; a *partial involucre*, the base of one of the umbels which compose a compound umbel.

Keel—a sharp, narrow ridge; in Leguminous plants, the boat-shaped organ formed by the cohesion of the two lowest petals.
Keeled—possessing a keel.

Labellum—the lip or lowest petal (originally the uppermost) of Orchids.
Lamina—the expanded portion or blade of a leaf.
Lanceolate—narrowly elliptic and pointed.
Lax—loosely arranged; not close together.
Leaflet—the division of a compound leaf.
Legume—a pod.
Ligulate—strap-shaped.
Ligule—the membranous process at the top of the leaf-sheath in Grasses.
Limb—the free portion of a petal or sepal.
Linear—long, narrow, and parallel-sided.
Lip—the lip-shaped anterior portion of a calyx or corolla.
Lyrate—pinnatifid, with the lobes increasing in size upward.

Male—bearing stamens, but not pistils.
Membranous—thin and pellucid.
Midrib—the straight central main vein of a leaf.
Monocotyledonous—having only one seed-leaf.
Monœcious—bearing the male and female organs on the same plant.
Monopetalous—having the petals joined together into one.
Monosepalous—having the sepals joined together into one.

Netted—traversed by raised lines arranged in a network.
Node—the point of a stem where a leaf is given off.
Nut—a dry, hard, indehiscent, one-seeded fruit.

Oblong—long oval, like a parallelogram with rounded corners.
Obcordate—heart-shaped, with the broad end uppermost.
Ocrea—the membranous collar-like stipule of *Polygonum*.
Opposite—springing from opposite sides of any point on a stem.
Oval—shaped like an ellipse.
Ovary—the young seed-vessel.
Ovate—egg-shaped; oval, but broader at the lower end than at the upper.
Ovoid—a solid egg-shaped figure.
Ovule—the young seed.

Palmate—divided like a hand.
Panicle—a raceme with branching pedicels.
Pappus—the persistent calyx-limb of *Compositæ*, altered into a tuft of hairs.
Parallel—maintaining the same distance apart; maintaining a proportionate distance apart.
Parasite—a plant that feeds on the juices of other plants.
Pedicel—the stalk of a single flower of a raceme or other compound inflorescence.
Peduncle—a flower-stalk.
Pellucid—semi-transparent.
Peltate—having the stalk inserted near the centre.
Perennial—living for several or many years.
Perfect—bearing fully-developed stamens and pistils.
Perfoliate—having the leaves joined together round the stem.
Perianth—the floral envelope; the calyx or corolla, or both when present.
Pericarp—the seed-vessel.
Persistent—not soon falling off.
Petal—a member of the corolla; a corolla-leaf.
Petaloid—resembling a petal.
Petiolate—having a petiole or leaf-stalk.
Petiole—the stalk of a leaf.
Phanerogam—a flowering plant, *i.e.* a species furnished with stamens and pistils.
Phyllary—a bract of the involucre in *Compositæ*.
Pinna—a leaflet; a division of a pinnate leaf.
Pinnate—a pinnate leaf bears separate leaflets on each side of a common stalk.
Pinnatifid—cut almost to the midrib; nearly pinnate.
Pistil—the ovary, style, and stigma.
Pitted—bearing numerous minute depressions.
Placenta—the portion of the carpel to which the ovules are attached.
Plumule—the stem of an embryo.
Pod—a one-celled two-valved seed-vessel consisting of a single carpel.
Pollen—the fecundating grains contained in the anther.
Pollen-tube—the slender outgrowth of a pollen-grain when it reaches a stigma.

Pollination—the act or process by which pollen reaches the stigma.
Pollinium—a mass of coherent pollen.
Procumbent—prostrate.
Proterandrous—shedding the pollen before the stigmas are mature.
Pubescent—downy.

Quinate—growing in fives from one point.

Raceme—a spike-like inflorescence in which each flower is stalked.
Racemose—bearing or consisting of a raceme.
Radiant or *Radiate*—possessing or resembling a ray.
Radical—springing from the summit of the root or root-stock.
Radicle—the root of an embryo.
Ray—the ring of spreading florets in the flower-heads of Composite plants like the Daisy ; the branch of an umbel.
Rayed—possessing a ray.
Receptacle—the flattened top of a stem on which flowers or flower-heads are borne.
Reflexed—bent backwards or downwards.
Respiration—the process by which plants absorb oxygen and exhale carbonic acid.
Revolute—rolled backwards.
Rhizome—a subterranean creeping stem producing leaves and roots, &c.
Root—the downward-growing leafless water-absorbing portion of a plant.
Root-leaf—a leaf springing from just above the root.
Root-stock—a stem which does not rise into the air.
Rostellum—a projection between the stamen and stigma in an Orchid flower.
Rudimentary—only partially developed.
Runner—a trailing shoot emitting leaves and roots at distant points.

Sagittate—shaped like a barbed arrow-head.
Saprophyte—a plant which feeds on humus or decaying vegetable matter.
Scape—a leafless radical flower-stem.
Seed—the mature ovule.
Sepal—a member of the calyx ; a calyx-leaf.
Serrate—having a margin toothed like a saw.
Sessile—without a stalk.
Sheath—that portion of a leaf or petiole which clasps round the stem.
Sheathing—wrapping round.
Shrub—a plant producing a perennial woody stem, but not attaining the dimensions of a tree.
Shrubby—like a shrub ; bushy.
Simple—not divided ; not compound.
Spadix—a succulent stem bearing crowded sessile flowers.
Spathe—a sheath or large bract enclosing an inflorescence.
Spike—a long unbranched flower-stem bearing a number of sessile flowers.
Spur—a narrow tubular backward prolongation of a corolla ; a backward hollow extension at the base of any organ.

Stamen—a pollen-bearing organ.
Standard—the large upper petal of Leguminous flowers.
Stigma—the cellular portion of a pistil to which pollen must adhere to secure the fertilisation of the ovule.
Stipule—leaf-like organs situated at the base of a petiole.
Stomata—minute openings in the epidermis of leaves through which carbonic acid is absorbed and water given out.
Style—the stalk which supports the stigma.
Sub prefixed to any term signifies *nearly*.
Sucker—a leafy stem produced by an underground shoot.
Superior—placed above anything; a *superior perianth* is situated on the top of the ovary; a *superior ovary* has the perianth placed below and distinct from it.

Tendril—an organ modified to support a stem by clasping surrounding objects.
Terminal—placed at the extremity.
Ternate—growing in threes from one point, as applied to leaflets.
Testa—the coat or skin of a seed.
Trifid—cut half-way down into three segments.
Trifoliate—consisting of three leaflets.
Trigonous—three-sided.
Trimorphous—having the same organ of three lengths or shapes in different flowers of the same species.
Tripinnate—thrice pinnate; bipinnate with pinnate divisions.
Truncate—ending abruptly as if cut across.
Tuber—a fleshy shortened underground stem or bud.
Tubercle—a minute knob or wart-like projection.

Umbel—an inflorescence formed by many stalked flowers springing from one point and forming a flattish surface. A *compound umbel* consists of a number of simple umbels arranged on peduncles which spring from one point; the simple umbels are in this case distinguished as *partial umbels* or *umbellules*.
Umbellate—arranged in an umbel.
Umbellule—see under *Umbel*.

Veins—bundles of vessels in leaves, &c.
Ventricose—swollen more on one side than on the other.
Vessel—"a tube consisting of cells which have become confluent by the partial or complete absorption of the intervening walls."
Viscous—sticky, clammy.

Whorl—a ring of similar organs.
Wing—a membranous expansion; in Leguminous flowers, one of the two lateral petals.

Two adjectives connected by a hyphen signify that the object described is intermediate between the two or compounded of the two.

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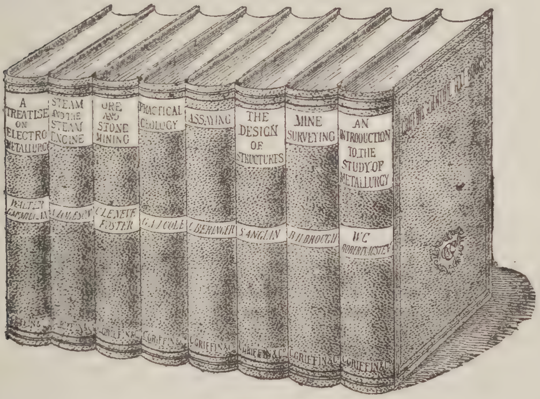

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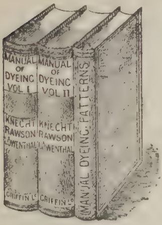

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